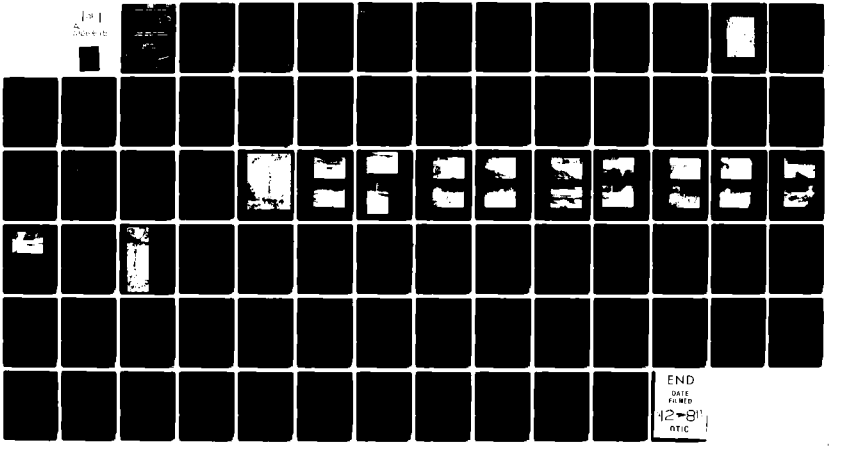
AD-A106 618 HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BARNS LAKE DAM (MO 31218), MISSISS--ETC(U)
OCT 80 R S DECKER, G G JAMISON, G ULMER DACW43-80-C-0071

UNCLASSIFIED NL



END
DATE FILMED
12-80
DTIC

LEVEL II

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

AD A106618

GARMS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31218

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

OCTOBER, 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER / 2. GOVT ACCESSION NO. AD-A106 618	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Garms Lake Dam (MO 31218) Cape Girardeau, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-80-C-0071 ✓
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE October 1980
	13. NUMBER OF PAGES Approximately 75
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

GARMS LAKE DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. MO 31218

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Garms Lake Dam (MO 31218),
Mississippi - Kaskaskia - St. Louis Basin,
Cape Girardeau County, Missouri. Phase I
Inspection Report.

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

OCT [redacted]80

9 Final rept.,

15 DACW43-80-C-0071

10 Rey S. /Decker Gordon G. /Jamison
Garold /Ulmer Harold P. /Hoskins

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Garms Lake Dam - MO 31218

This report presents the results of field inspection and evaluation of the Garms Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

17 MAY 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

11 MAY 1981
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

APPENDIX A - MAPS

Plate A-1		Vicinity Topography
Plate A-2		Location Map
Plate A-3		Seismic Map

APPENDIX B - PHOTOGRAPHS

Plate B-1	Photo Index	
Plate B-2	Photo No. 2	Overview Taken from the Left Side
	Photo No. 3	Upstream Slope Taken from the Right End
Plate B-3	Photo No. 4	Crest of Dam from the Right End
	Photo No. 5	Crest Looking Over the Spillway Cut
Plate B-4	Photo No. 6	Downstream Slope from the Right End
	Photo No. 7	Downstream Slope Taken from Left End
Plate B-5	Photo No. 8	Looking Downstream from Sta. 3+00
	Photo No. 9	Looking Upstream in the Spillway
Plate B-6	Photo No. 10	Looking Downstream in the Spillway
	Photo No. 11	Looking Upstream in the Small Spillway on the Right Side of the Lake
Plate B-7	Photo No. 12	Looking Downstream in the Spillway on the Right Side of the Lake
	Photo No. 13	Looking Down the Valley Below the Spillway on the Right Side of the Lake. Highway in the Distance.
Plate B-8	Photo No. 14	Seepy Spot Downstream of Sta. 1+65 in the Left Abutment Trough
	Photo No. 15	Looking Upstream at Seepage Area in the Left Abutment Trough
Plate B-9	Photo No. 16	Seepy Area Downstream from Sta. 3+00
	Photo No. 17	Looking Upstream About the Center of the Dam
Plate B-10	Photo No. 18	House or Dwelling at 0.5 Mile of Dam. Dwelling is Very High Above Floodplain.
	Photo No. 19	Dwelling at 0.8 Mile Below the Dam. The Dwelling is Approximately 25 Feet Above the Creek Bed.
Plate B-11	Photo No. 20	Two Buildings Located at 0.8 Mile Downstream and Dwelling in Background at About 0.95 mile.

APPENDIX C - PROJECT PLATES

Plate C-1	Phase I - Plan and Centerline Profile of Dam
Plate C-2	Phase I - Maximum Cross Section at Sta. 3+00 and Profile Along Centerline of North Spillway
Plate C-3	Phase I - North Spillway Cross Sections
Plate C-4	Phase I - Profile Along Centerline of South Spillway and South Spillway Cross Sections

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 & D-2	Hydrologic Computations
Plate D-3	North Spillway Discharge Rating Curve
Plate D-4	South Spillway Discharge Rating Curve
Plate D-5	Elevation-Area and Elevation-Capacity Curves
Plates D-6 through D-32	Computer Input and Output for Ratios of the PMF

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Garms Lake Dam
State Located	Missouri
County Located	Cape Girardeau County
Stream	Tributary to Cape La Croix Creek
Date of Inspection	October 30, 1980

Garms Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Garms Lake Dam has a height of thirty-two (32) feet and a storage capacity at the minimum top elevation of the dam of sixty-seven (67) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Garms Lake Dam is classified as a small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having significant downstream hazard potential. Failure may damage isolated homes, secondary highways or minor railroads, or cause interruption of use or service of relatively important public utilities. The estimated damage zone extends approximately two (2) miles downstream of the dam. Within the damage zone are a medium-duty road at 0.6 mile, two buildings at 0.8 mile, and a building at 0.95 mile. There are also four dwellings located in the damage zone. All of these dwellings are located above the high water mark that may result from dam failure.

Our inspection and evaluation indicates that the spillways meet the minimum criteria set forth in the recommended guidelines for a small dam having a significant hazard potential. Considering the volume of water impounded and the downstream hazards, the 100-year flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (one percent probabilistic flood, a flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 40% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Garms Lake Dam is in very good condition. The only deficiency observed was the growth of trees and bushes on the embankment. Seepage and stability analyses, although not specifically required for small dams having a significant hazard potential, are recommended because of the dam's location in Seismic Zone 3.

Based on visual observation and on the analyses made during and subsequent to the field inspection, the following recommendations are made:

a. Alternatives. The dam and its spillways will pass 40% of the probable maximum flood which is in the upper range of the recommended spillway design floods for a small size dam having a significant hazard potential. No alternative measures are required.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams. These analyses should include the appropriate seismic forces for Seismic Zone 3.

(2) Trees and bushes should be removed from the embankment and measures taken to prevent recurrent growth. Large trees or trees with an extensive root system should be removed under the guidance of an engineer experienced in the design and construction of dams.

(3) A program of periodic inspections should be established and records of the inspections should be made a part of this project file.

Rey S. Decker
E-3703

Gordon Jamison

Gordon Jamison

Garold Ulmer

Garold Ulmer
E-19246

H. P. Hoskins

Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GARMS LAKE DAM - MO 31218
CAPE GIRARDEAU COUNTY, MISSOURI

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Garms Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) Embankment. The embankment is an earthfill approximately 500 feet in length and 32 feet in height with a maximum storage capacity of 67 acre-feet at the minimum top elevation of the dam.

(2) North Spillway. The north spillway is an uncontrolled, vegetated earth cut through the left abutment. The spillway has a 12-foot bottom width and side slopes of 1V on 1.7 to 2.5 H. The spillway has a level control section approximately 40 feet in length just upstream of the centerline of the dam. The entrance channel has a length of about 20 feet on a negative grade of 3%. The exit channel has a positive grade of about 2%. A plan view, profile, and sections of the spillway are shown on Plates C-1, C-2 and C-4. Photo Nos. 5, 9 and 10 show views of the spillway.

(3) South Spillway. The south spillway is an uncontrolled, vegetated earth spillway located on the right side of the reservoir in natural soil. The spillway section is parabolic in shape and has an 11-foot wide by 18-foot long concrete apron for a control section. The exit channel has a positive grade of approximately 16%. A plan view, profile and sections of the spillway are shown on Plates C-1 and C-3. Photo Nos. 11, 12 and 13 show views of the spillway.

(4) Low-Level Outlet. There is no low-level or drawdown structure for this dam.

(5) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in the east central portion of Cape Girardeau County, Missouri, just northwest of Cape Girardeau, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the NW 1/4 of Section 15, T31N, R13E.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Garms Lake Dam has a height of 32 feet and a storage capacity of 67 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines, this dam is in the Significant Hazard Potential Classification. The estimated damage zone extends approximately two miles downstream of the dam. Within the damage zone are a medium-duty road at 0.6 mile, two buildings at 0.8 mile, and a building at 0.95 mile. There are also four dwellings located in the damage zone. All of these dwellings are located above the high water mark that may result from dam failure.

e. Ownership. The dam is owned by Mr. Irwin H. Garms, Route 2, Box 5580, Cape Girardeau, Missouri 63701.

f. Purpose of Dam. The dam impounds a recreational lake covering about 5 acres and containing about 60 acre-feet of water.

g. Design and Construction History. No design or construction data were available. It was reported by Mrs. I. H. Garms that the

dam was built in 1968 by Crites and Siler Construction Company. No other information was available on design or construction of the dam.

h. Normal Operating Procedure. There are no operating facilities for this dam except for a small pump located on the boat dock near the right abutment.

1.3 PERTINENT DATA

a. Drainage Area. 23 acres (0.036 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through an uncontrolled, vegetated earth spillway cut through the left abutment and an uncontrolled, vegetated earth spillway with a concrete apron control section located on the south or right side of the reservoir.

(2) Estimated maximum flood at damsite -- unknown.

(3) The south spillway capacity varies from 0 c.f.s. at elevation 516.7 feet to 4 c.f.s. at the crest of the north spillway (elevation 516.9 feet) to 85 c.f.s. at the minimum top of dam (elevation 518.0 feet).

(4) The north spillway capacity varies from 0 c.f.s. at its crest (elevation 516.9 feet) to 25 c.f.s. at the minimum top of dam (elevation 518.0 feet).

(5) Total spillway capacity at the minimum top of dam is 110 c.f.s. ±.

c. Elevations (feet above M.S.L.).

(1) Observed pool - 514.5

(2) Normal pool - 516.2

(3) Spillway crests

North spillway - 516.9

South spillway - 516.7

(4) Maximum experienced pool - unknown

(5) Top of dam (minimum) - 518.0

(6) Streambed - 486±

(7) Maximum tailwater - unknown

d. Reservoir. Length (feet) of pool.

(1) At north spillway crest - 800±

(2) At south spillway crest - 800±

(3) At top of dam (minimum) - 900±

e. Storage (acre-feet).

(1) Observed pool - 50±

(2) Normal pool - 58±

(3) Spillway crests

North spillway - 62±

South spillway - 60±

(4) Maximum experienced pool - unknown

(5) Top of dam (minimum) - 67±

f. Reservoir Surface (acres).

(1) Observed pool - 4.4±

(2) Normal pool - 4.9±

(3) Spillway crests

North spillway - 5.3±

South spillway - 5.1±

(4) Maximum experienced pool - unknown

(5) Top of dam (minimum) - 5.5±

g. Dam.

(1) Type - earthfill

(2) Length - 500 feet ±

(3) Height - 32 feet ±

(4) Top width - 12 feet ±

(5) Side slopes

(a) Downstream - 1V on 2.4 H ±

(b) Upstream - 1V on 4 H (measured on exposed slope)

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

(10) Wave protection - none except vegetation

(11) Drains - unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillways.

(1) North Spillway

(a) Type - vegetated earth, uncontrolled, cut through the left abutment. Bottom width - 12 feet; side slopes - 1V on 1.7 to 2.5 H.

(b) Control section - 40-foot level section.

(c) Crest elevation - 516.9 feet (m.s.l.).

(d) Upstream channel - vegetated, open, -3% grade.

(e) Downstream channel - vegetated, open, 2% grade.

(2) South Spillway

(a) Type - uncontrolled, vegetated earth, located on the saddle on the right or south side of the reservoir.

(b) Control section - 11-foot wide by 18-foot long concrete apron on 32-foot level section.

(c) Crest elevation - 516.7 feet (MSL)

(d) Upstream channel - vegetated, open, approximate -2.4% grade.

(e) Downstream channel - vegetated, open, 16% grade.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data was available. It was reported by Mrs. I. H. Garms that the dam was constructed in 1968 by Crites and Siler Construction Company.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mrs. I. H. Garms that the spillways flow each winter approximately 2 to 3 inches deep. The flow through the spillways has been known to last for as much as a week at a time some winters.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. Although not specifically required for a small size dam having a significant hazard potential, it is recommended that the analyses be conducted because of the location of the dam in Seismic Zone 3.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Garms Lake Dam was made on October 30, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology
Roy Elliott - Geology

Mrs. I. H. Garms was interviewed prior to the inspection but was not present during the inspection.

b. Dam.

(1) Geology and Soils (abutment and embankment). This embankment is situated in the loess mantled uplands on the eastern border of the Ozark Physiographic Province. The geologic setting is dominated by the Radio Tower structure obscured by the loess mantle. The predominate soil association is the Memphis-Loring upland association.

The embankment is composed of a mixture of clayey silts with a chert and carbonate clastic fraction. These materials are derived from the slightly plastic silts (ML) of the loess mantle and the highly plastic clayey silts (CH-MH) of the underlying residual soil mantling the bedrock. The alluvium is composed of chert, carbonate sand and gravel and clayey silt.

The abutments consist of 5 to 10 feet of loess, a 1 to 5-foot residual soil on the bedrock. The bedrock is probably the Plattin formation of Ordovician age. The stratigraphy in this section is complex due to the Radio Tower structure. This structure is apparently a collapse in the Plattin formation during an earlier geologic epoch preserving the overlying sediments. Other significant structures within this area are the Jackson fault, the Girardeau fault and the Brooks Dome.

The embankment occurs in Seismic Zone 3, indicative of major probability of seismic activity. Earthquakes with modified Mercalli intensities equal to or greater than V occurred in 1812, 1819, 1878, 1882, 1903, 1905, 1909, 1930, 1974 and 1977.

Solution cavitation was not observed in the exposed bedrock of this valley. Water movement in the bedrock was minor with seepage detected along the bedding planes. Groundwater movement at the embankment is controlled by the alluvium and residual soil of the abutment. Phreatophytes cover the slope below the left abutment.

(2) Upstream Slope. The upstream slope is well covered with adapted grasses from the crestline down to near the waterline. Cattails are growing at the waterline along the entire length of the dam. A few small trees and some brush are also growing on the slope. There was no significant erosion observed on the upstream slope. There were no cracks, slides, slumps, deformations or rodent holes. The upstream slope is shown in Photo No. 3.

(3) Crest. The crest is well vegetated with adapted grasses. Materials on the crest are CL-ML with considerable quantities of cherty gravel. Materials were field identified from samples taken by hand auger. The profile of the crest shows the low point to be midway between the two abutments at the approximate location of the original channel. The profile slopes almost uniformly from both abutments to the low point. Some settlement has undoubtedly occurred since construction. The low point of the crest is approximately 2 feet lower than either abutment and 1.4± feet higher than the control sections of the two spillways. No cracks, deformations, rodent holes or evidence of unequal settlement were observed. The crest is used as a roadway on occasion. Photos 4 and 5 show the crest. The tree in the foreground of Photo No. 5 is growing in the abutment and should not cause any problems.

(4) Downstream Slope. The downstream slope is also well vegetated with adapted grasses. Many small trees and bushes are growing on the slope. Cattails are growing in the left abutment trough and along and downstream of the toe of the dam from Station 1+65± to Station 3+00±. Mrs. Garms reported that there was a spring in the area of the cattail growth prior to the construction of the dam.

Water was standing in the cattail growth at the time of the inspection, but it was not possible to determine a rate of flow. There was no evidence of seepage in the right abutment trough or along the toe of the dam on the right (south) side of the old channel. There also was no evidence to indicate that the dam has been overtopped. No cracks, slides, slumps, deformations or rodent holes were observed. Photos 6, 7 and 8 show the downstream slope. Photos 14, 15 and 16 show the cattail growth.

c. Appurtenant Structures.

(1) South Spillway. The uncontrolled south spillway is located approximately 130 feet west of the south abutment contact of

the dam. The spillway is cut through the ridge line that defines two drainageways. Flows through this spillway are diverted across the ridgeline away from the channel in which the dam is located. The 11-foot by 18-foot concrete control section is in good condition and shows no signs of distress. The earthen approach section from the lake is well vegetated and unobstructed except for cattail growth along the water's edge. The channel downstream from the concrete control section is well vegetated. Trees growing on each side of the channel approximately 30 to 40 feet from the downstream end of the control section should not materially affect flows. The downstream channel is not eroded. Photos 11, 12 and 13 show the south spillway.

(2) North Spillway. The north spillway is an excavated earth channel through the left abutment of the dam. The spillway is well vegetated and is free of obstructions with the exception of a few small saplings growing near the water's edge. Photos 5, 9 and 10 show views of the spillway.

(3) Low-Level Outlet. There is no low-level outlet for this dam.

d. Reservoir Area. No significant erosion was evident around the shoreline. Much of the shoreline of the lake supports cattail growth. There was no evidence of siltation in the lake. Photos 1, 2, and 17 show views of the lake.

e. Downstream Channel. The downstream channel of the north spillway is covered with a native growth of brush and trees as shown in Photos 1 and 8. The channel appears to be stable. The channel downstream from the south spillway is vegetated and open as shown in Photos 1 and 13. This channel also appears to be stable.

3.2 EVALUATION

This dam appears to be in very good structural condition with little potential of failure. The trees and bushes on the embankment could lead to a potential of failure if allowed to continue to grow. The spillways appear to be in excellent condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

The dam appears to be well maintained with the exception of the tree and brush growth on the embankment.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam except for the small pump located on the boat dock near the right abutment.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

Uncontrolled tree growth on the embankment could eventually lead to potential of failure. The trees and bushes on the embankment should be removed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Cape Girardeau, Missouri 7-1/2 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection. Hydraulic/hydrologic computations are included as Appendix D of this report.

c. Visual Observations.

(1) Both spillways appeared to be in excellent condition. Spillway releases should not endanger the integrity of the dam.

(2) A small pump was located on the boat dock located at the right end of the dam. It is assumed it is used to pump water for irrigating purposes; however, the exact intent and operational procedures are not known. The capacity of the pump would have no impact on the storm routings.

d. Overtopping Potential. The spillways are too small to pass one-half of the Probable Maximum Flood (PMF) without overtopping the dam. The existing spillways will pass 40% of the PMF and the 1 percent probability flood without overtopping the dam. The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam Feet	Duration Over Top Hours
1% Flood	75	16	517.3	0	0
1/2 PMF	220	150	518.1	0.1	1-
PMF	450	390	518.6	0.6	1+
0.4 PMF	180	110	518.0	0	0

* Minimum top of dam elevation - 518.0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a significant hazard rating and a small size. Therefore, the 1% probability flood to the 1/2 PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in paragraph 1.2.d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. Based on visual observation this dam appears to be in very good condition and structurally stable with little potential of failure. There was no evidence of cracks, slides, slumps, erosion or deformation. There were no rodent holes. The normal slopes and nature of material in the dam should provide adequate safety against shear failure for a dam of this height. Seepage from the spring reported by Mrs. Garms does not appear to affect the stability of the dam.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. Although not specifically required for a small size dam having a significant hazard potential, it is recommended that the analyses be conducted because of the location of the dam in Seismic Zone 3.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post-Construction Changes. The inspection team is not aware of any post-construction changes.

e. Seismic Stability. This dam is located in Seismic Zone 3. An earthquake of the magnitude predicted in this area could be expected to cause some damage to this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Based on visual observation, this dam appears to be in very good structural condition with little potential of failure. The only deficiency observed during the inspection was the growth of trees and bushes on the embankment. If allowed to continue to grow, a potential of failure could result. The spillways are in excellent condition and will pass 40% of the probable maximum flood before overtopping of the dam would occur. Minor overtopping (approximately 0.1 foot for a period of about 1 hour) could be expected from 50% of the probable maximum flood. This minor overtopping should not cause serious damage to the dam.

b. Adequacy of Information. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. Although not specifically required for a small dam having a significant hazard potential, it is recommended that the analyses be conducted because of the location of the dam in Seismic Zone 3.

c. Urgency. There does not appear to be an immediate urgency to accomplish the remedial measures recommended in paragraph 7.2.

d. Necessity for Further Investigations. The analyses recommended in paragraph 7.2.b should be accomplished by the owner in the near future.

e. Seismic Stability. This dam is located in Seismic Zone 3. An earthquake of this magnitude could be expected to cause some damage to this dam. It is recommended that the prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

a. Alternatives. The dam and its spillways will pass 40% of the probable maximum flood which is in the upper range of the recommended spillway design floods for a small size dam having a significant hazard potential. No alternative measures are required.

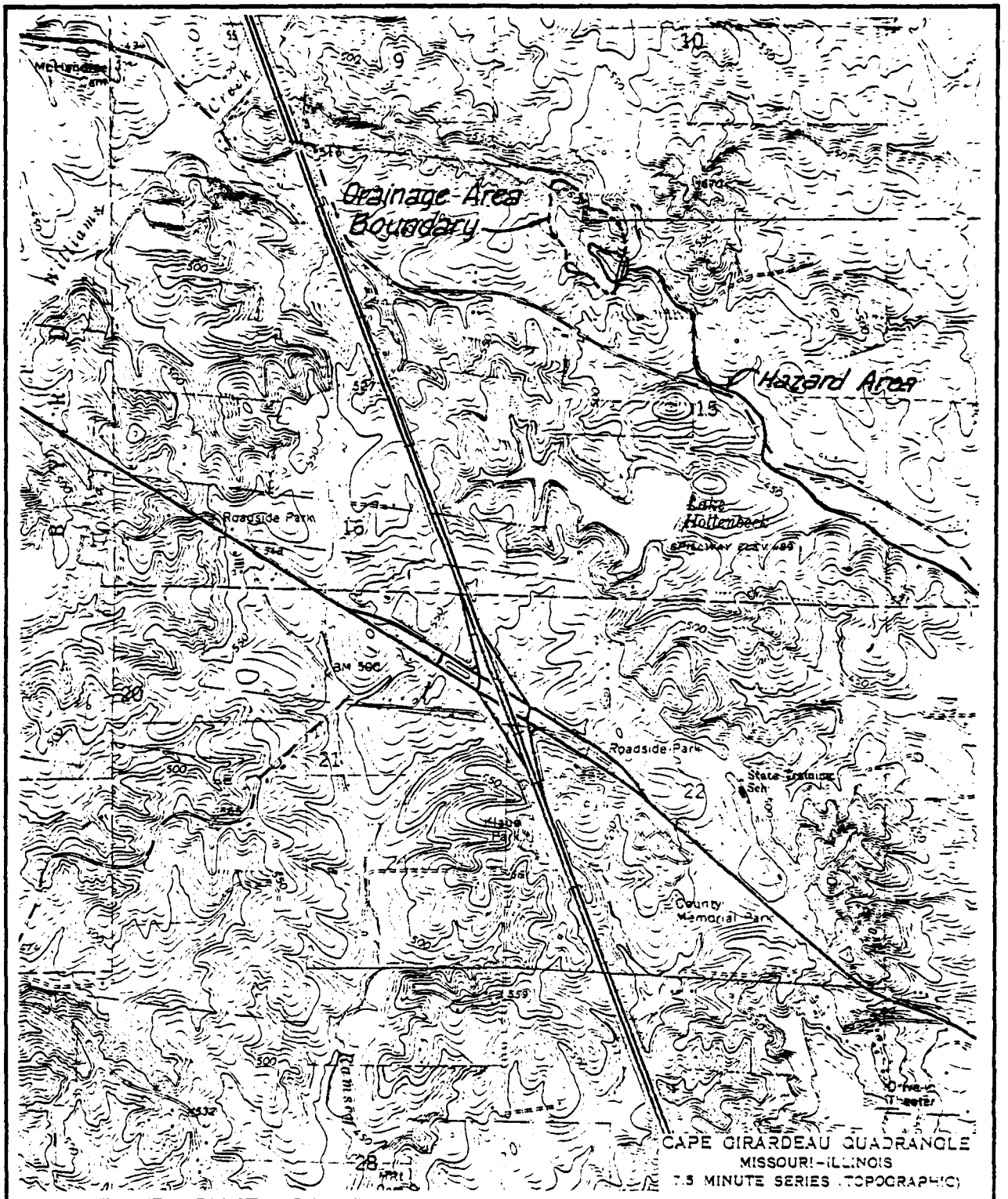
b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.

(2) Trees and bushes should be removed from the embankment and measures taken to prevent recurrent growth. Large trees or trees with an extensive root system should be removed under the guidance of an engineer experienced in the design and construction of dams.

(3) A program of periodic inspections should be established and records of the inspections should be made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval – 10'

N

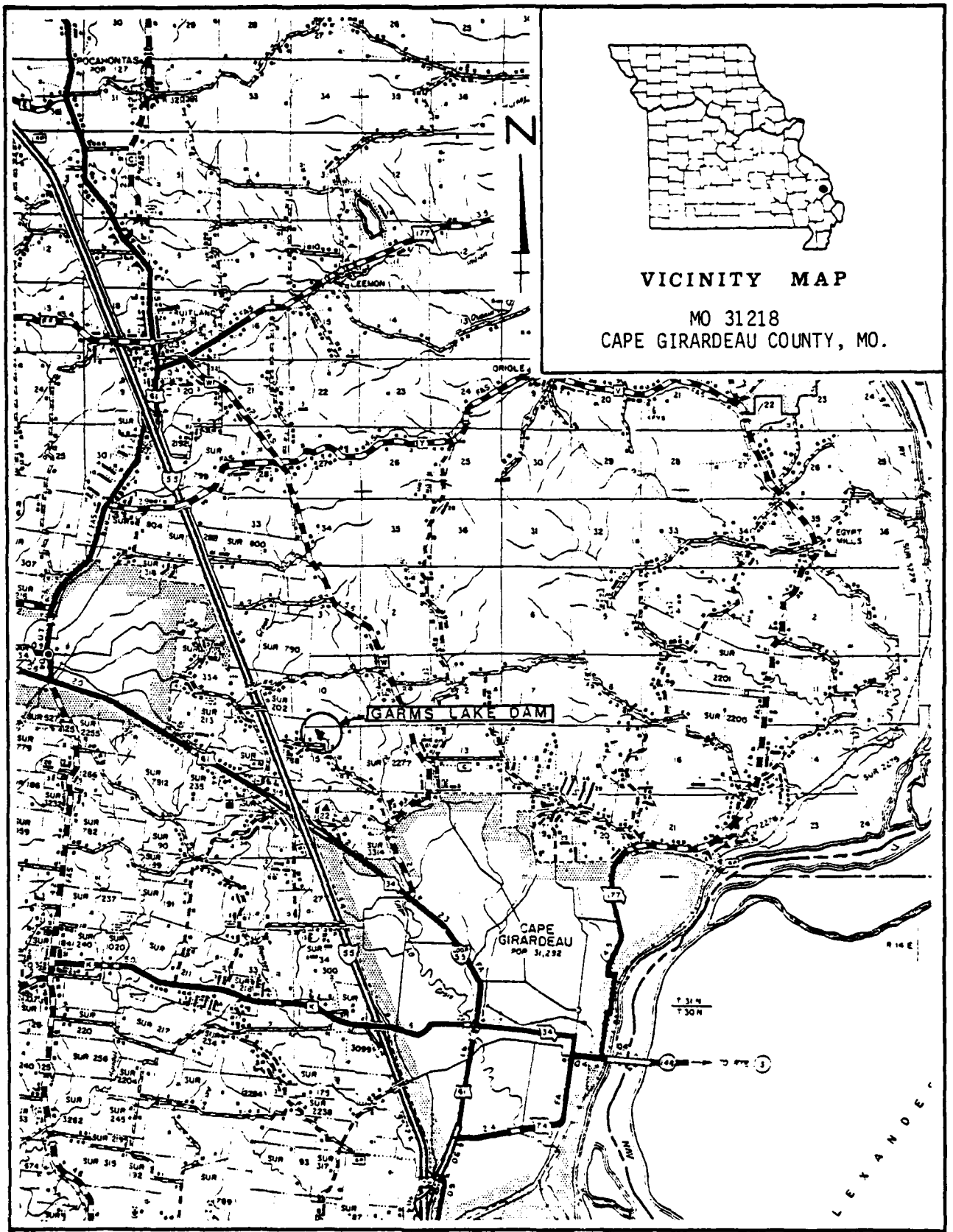
VICINITY TOPOGRAPHY

GARMS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31218

PLATE A-1



VICINITY MAP

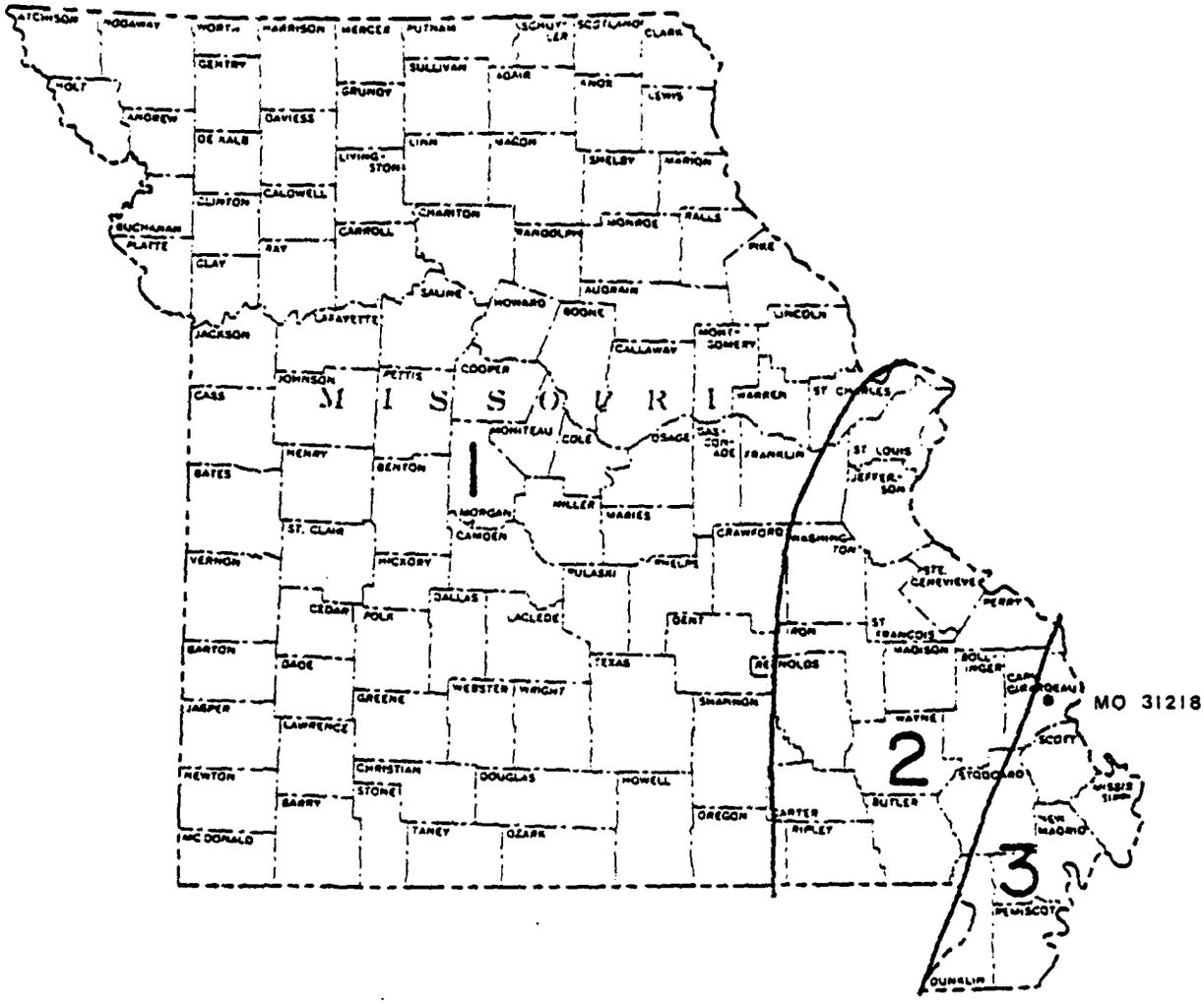
MO 31218
CAPE GIRARDEAU COUNTY, MO.

Scale in miles

0 1 2 3 4 5

LOCATION MAP

PLATE A-2



MISSOURI

SEISMIC ZONE MAP

PLATE A-3

APPENDIX B
PHOTOGRAPHS

GARMS LAKE DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MO. 31218

PHOTO INDEX

PLATE B-1

PHOTO NO. 2 - OVERVIEW TAKEN FROM THE LEFT SIDE.

PHOTO NO. 3 - UPSTREAM SLOPE TAKEN FROM THE RIGHT END.

PHOTO NO. 4 - CREST OF DAM FROM THE RIGHT END.

PHOTO NO. 5 - CREST LOOKING OVER THE SPILLWAY CUT.

PHOTO NO. 6 - DOWNSTREAM SLOPE FROM THE RIGHT END.

PHOTO NO. 7 - DOWNSTREAM SLOPE TAKEN FROM LEFT END.

PHOTO NO. 8 - LOOKING DOWNSTREAM FROM STA. 3+00.

PHOTO NO. 9 - LOOKING UPSTREAM IN THE SPILLWAY.

PHOTO NO. 10 - LOOKING DOWNSTREAM IN THE SPILLWAY.

PHOTO NO. 11 - LOOKING UPSTREAM IN THE SMALL SPILLWAY ON THE RIGHT SIDE OF THE LAKE.

PHOTO NO. 12 - LOOKING DOWNSTREAM IN THE SPILLWAY ON THE RIGHT SIDE OF THE LAKE.

PHOTO NO. 13 - LOOKING DOWN THE VALLEY BELOW THE SPILLWAY ON THE RIGHT SIDE OF THE LAKE. HIGHWAY IN THE DISTANCE.

PHOTO NO. 14 - SEEPY SPOT DOWNSTREAM OF STA. 1+65 IN THE LEFT ABUTMENT TROUGH.

PHOTO NO. 15 - LOOKING UPSTREAM AT SEEPAGE AREA IN THE LEFT ABUTMENT TROUGH.

PHOTO NO. 16 - SEEPY AREA DOWNSTREAM FROM STA. 3+00.

PHOTO NO. 17 - LOOKING UPSTREAM ABOUT THE CENTER OF THE DAM.

PHOTO NO. 18 - HOUSE OR DWELLING AT 0.5 MILE DOWNSTREAM OF DAM. DWELLING IS VERY HIGH ABOVE FLOODPLAIN.

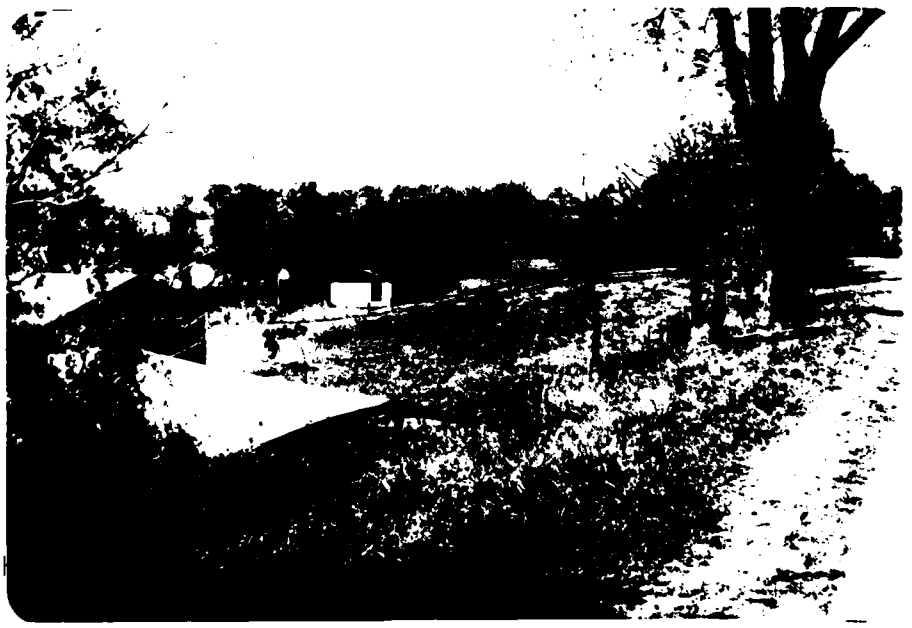
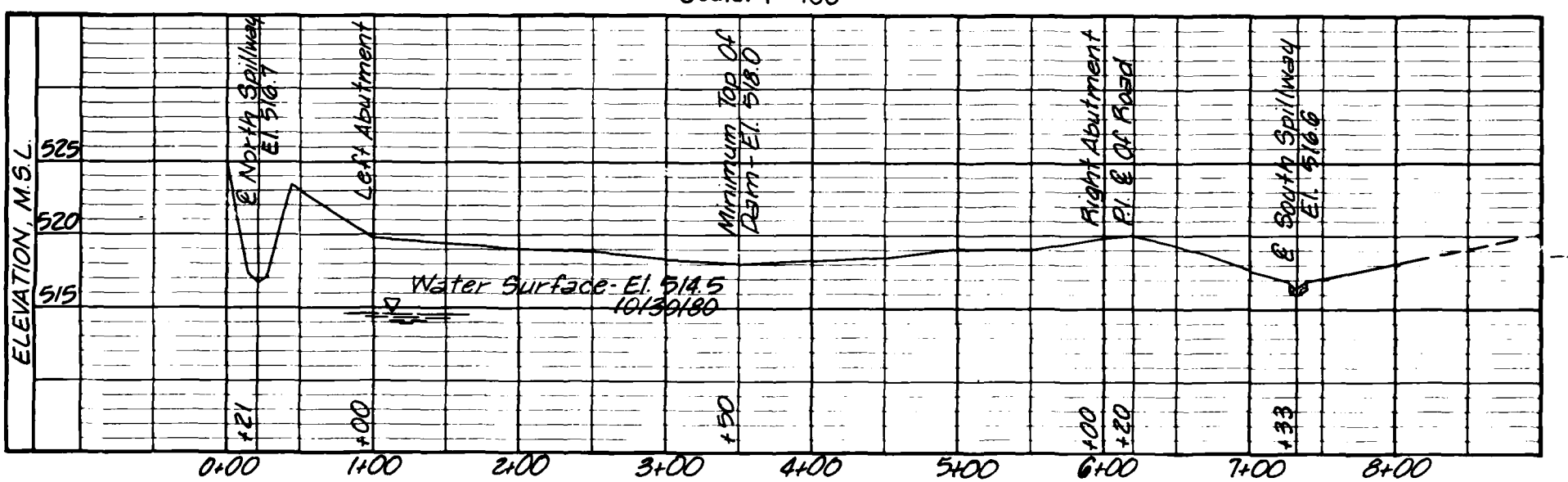


PHOTO NO. 19 - DWELLING AT 0.8 MILE BELOW THE DAM. THE DWELLING IS APPROXIMATELY 25 FEET ABOVE THE CREEK BED.

PHOTO NO. 20 - TWO BUILDINGS LOCATED AT 0.8 MILES DOWNSTREAM AND DWELLING IN BACKGROUND AT ABOUT 0.95 MILES.

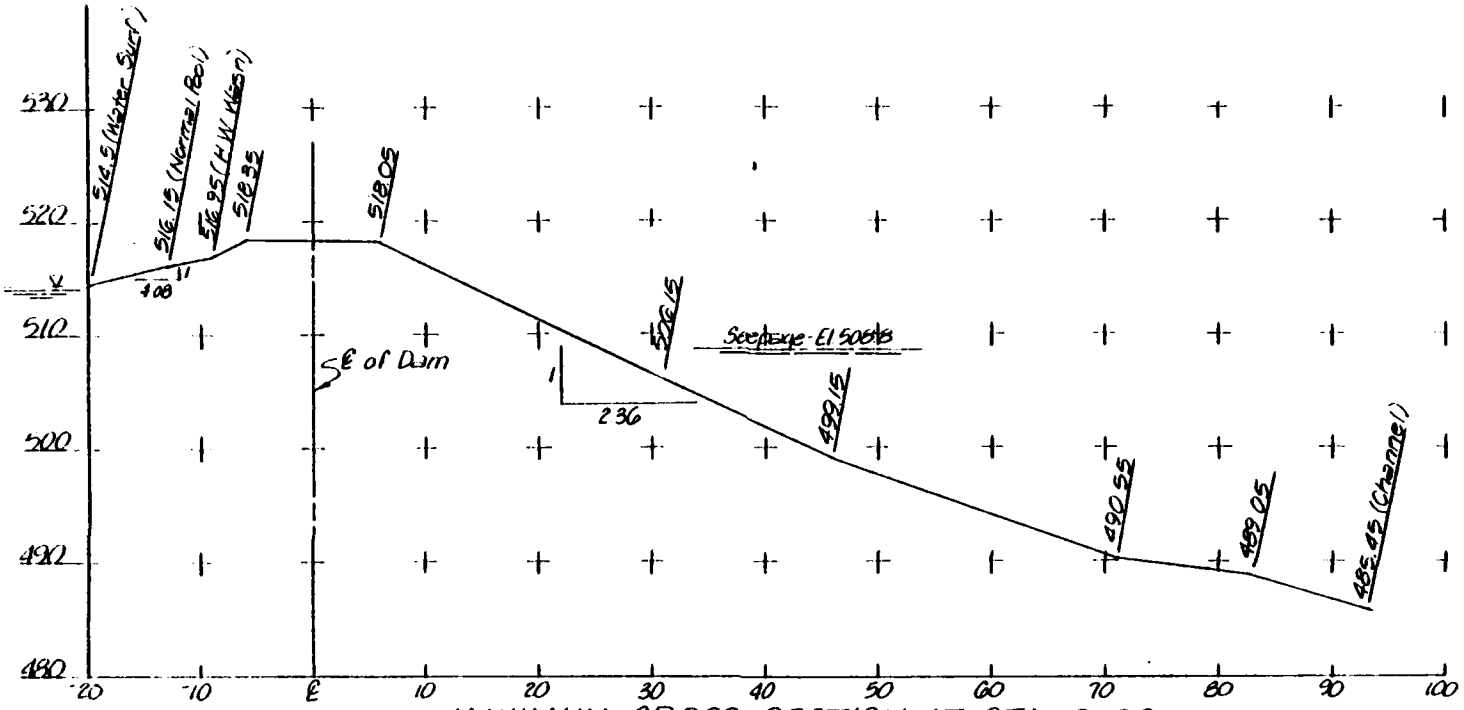
APPENDIX C
PROJECT PLATES

PLAN OF DAM
Scale: 1"= 100'



CENTERLINE PROFILE OF DAM
Scale As Shown

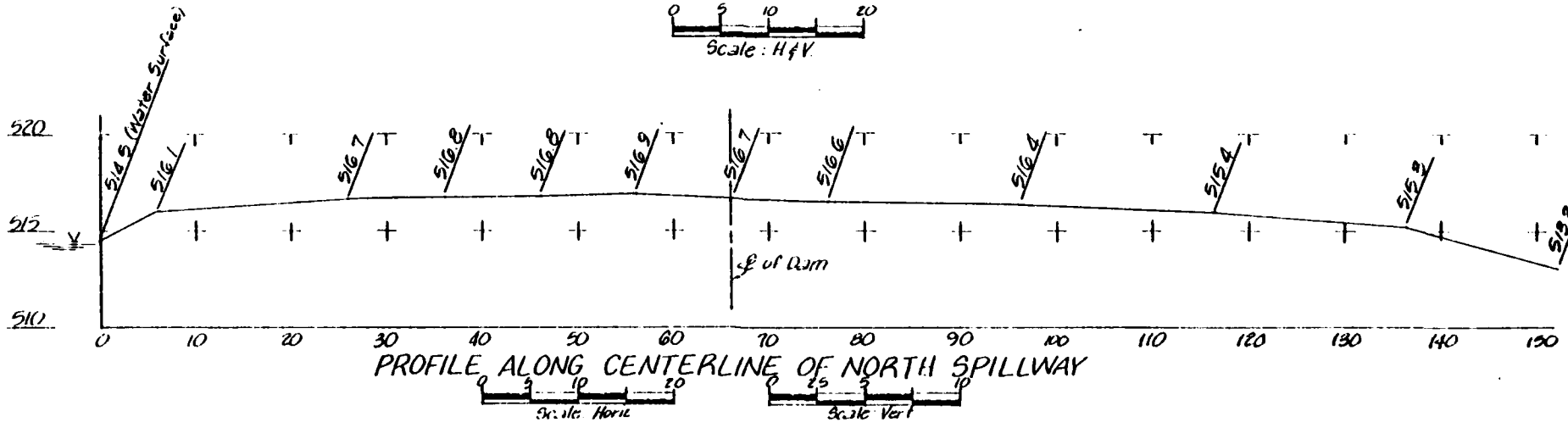
PLATE C-1



MAXIMUM CROSS-SECTION AT STA. 3+00

0 5 10 20

Scale : H & V



PROFILE ALONG CENTERLINE OF NORTH SPILLWAY

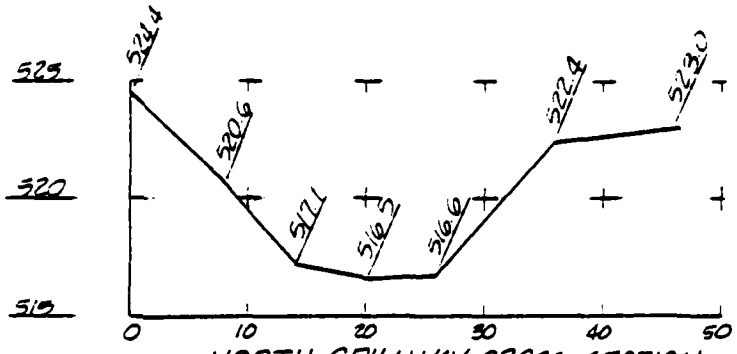
0 3 10 20

Scale: Horiz

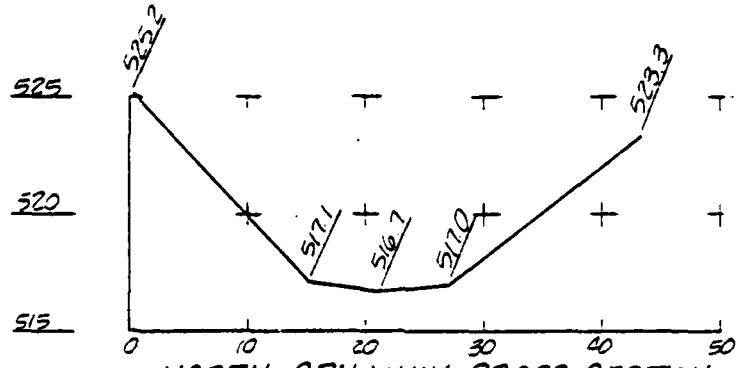
0 2.5 5 10

Scale: Vert

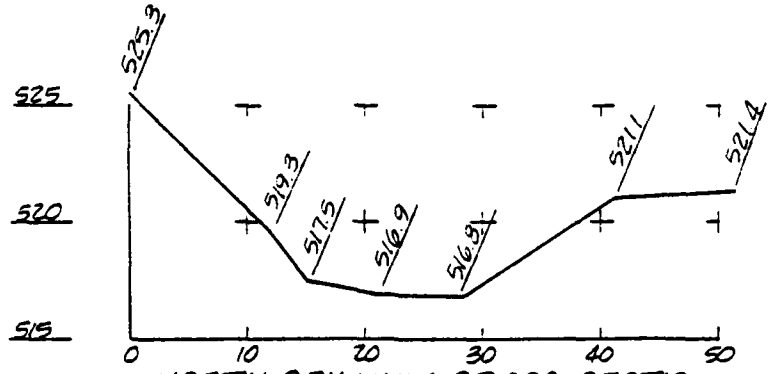
PLATE C-2



NORTH SPILLWAY CROSS-SECTION
20' DOWNSTREAM OF ℄.

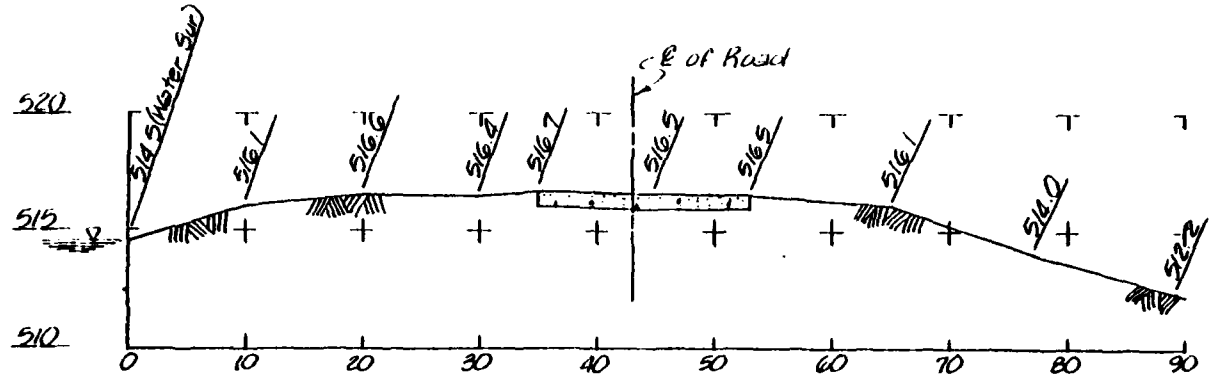


NORTH SPILLWAY CROSS-SECTION
℄ OF DAM

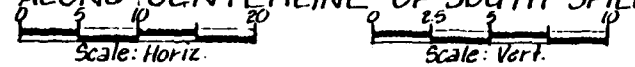


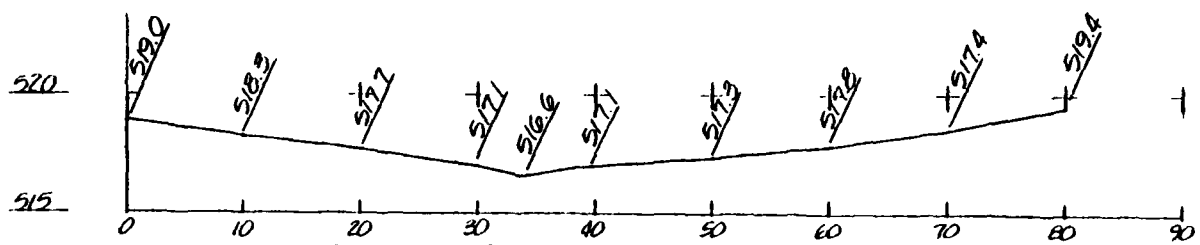
NORTH SPILLWAY CROSS-SECTION
20' UPSTREAM OF ℄

PLATE C-3

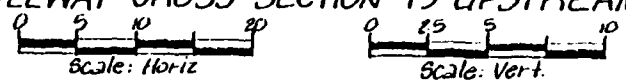


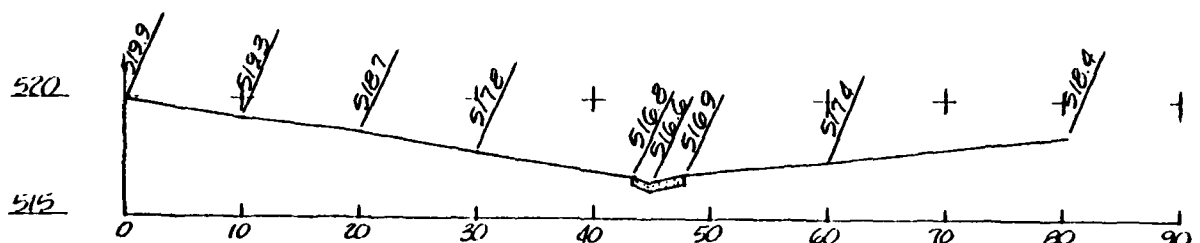
PROFILE ALONG CENTERLINE OF SOUTH SPILLWAY





SOUTH SPILLWAY CROSS-SECTION- 15' UPSTREAM OF ℄ OF ROAD





SOUTH SPILLWAY CROSS-SECTION- ℄ OF ROAD

PLATE C-4

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see this section).

   a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Cape Girardeau, Missouri, as supplied by the St. Louis District, Corps of Engineers per their letter dated 5 December 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.036 square miles (23 acres).

   c. Time of concentration of runoff = 7 minutes (computed from the "Kirpich" formula and verified using the equation from the California Culverts Practice, California Highways and Public Works Department).

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the south spillway.

   e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 3.82 inches. The total losses for the PMF storm were 2.50 inches. These data are based on SCS runoff curve No. 66 and No. 82 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups Menfro and Clarksville (hydrologic soil group "B"). Heavy, thick woods cover approximately one-half of the watershed with pasture covering the rest of the area.

   f. Average soil loss rates = 0.10 inch per hour approximately (for PMF storm, AMC III).

2. The combined discharge rating consisted of three components: the flow through the north spillway, the flow through the south spillway, the flow over the top of the dam. The discharge ratings for both the north and south spillway ratings were developed using the Corps of Engineers Surface Water Profile HEC-2 computer program assuming critical depth downstream of the control section. For the north spillway, a Mannings "n" value of 0.050 for the entrance channel and 0.040 for the control section and exit channel were used. For the south spillway, a Mannings "n" value of 0.050 for the entrance channel, 0.016 for the concrete control section, and 0.035 for the exit channel were used. The flows

over the dam crest were developed using the HEC-1 (Dam Safety Version) program using the irregular top of dam option.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The output and plotted hydrographs are shown in this section.

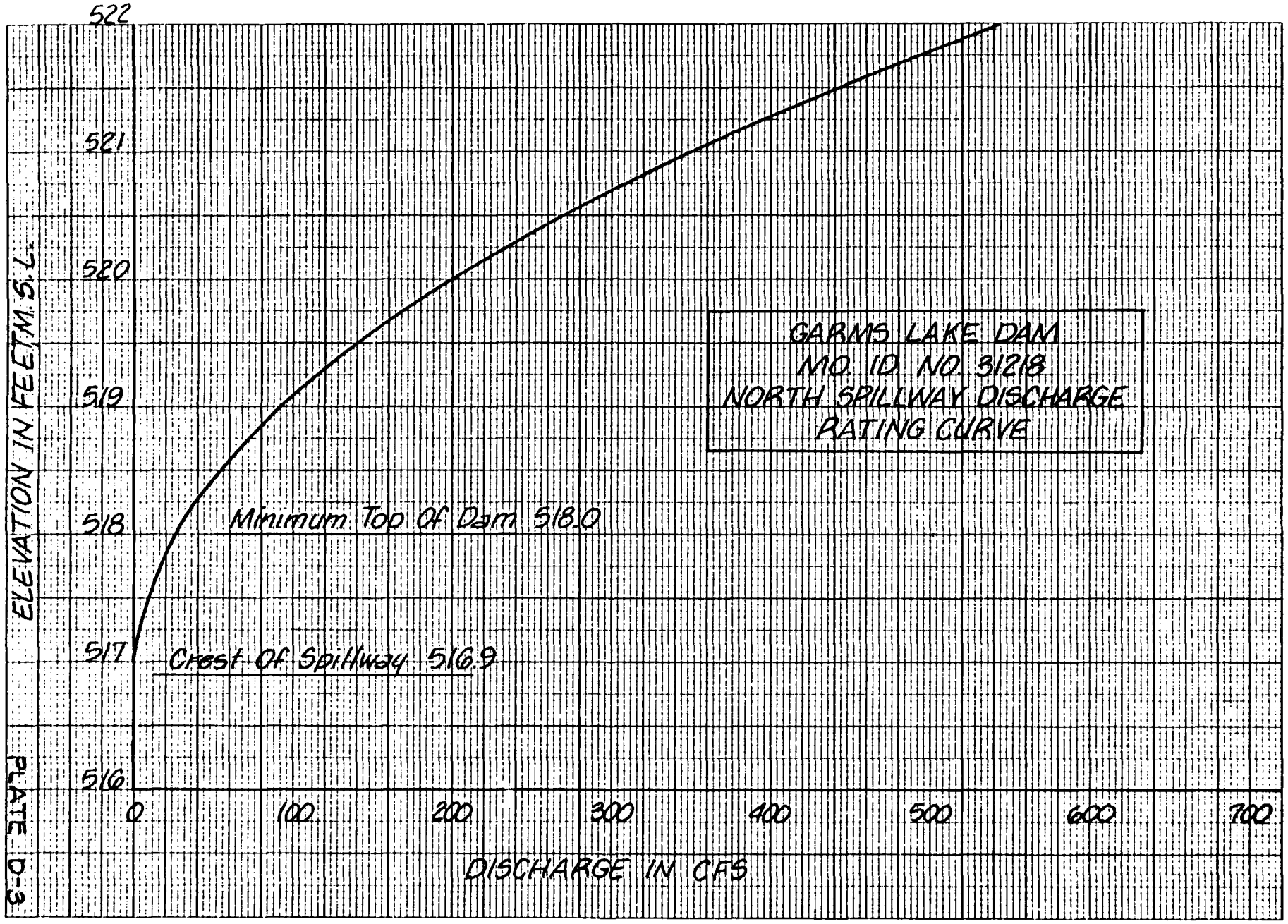


PLATE D-3

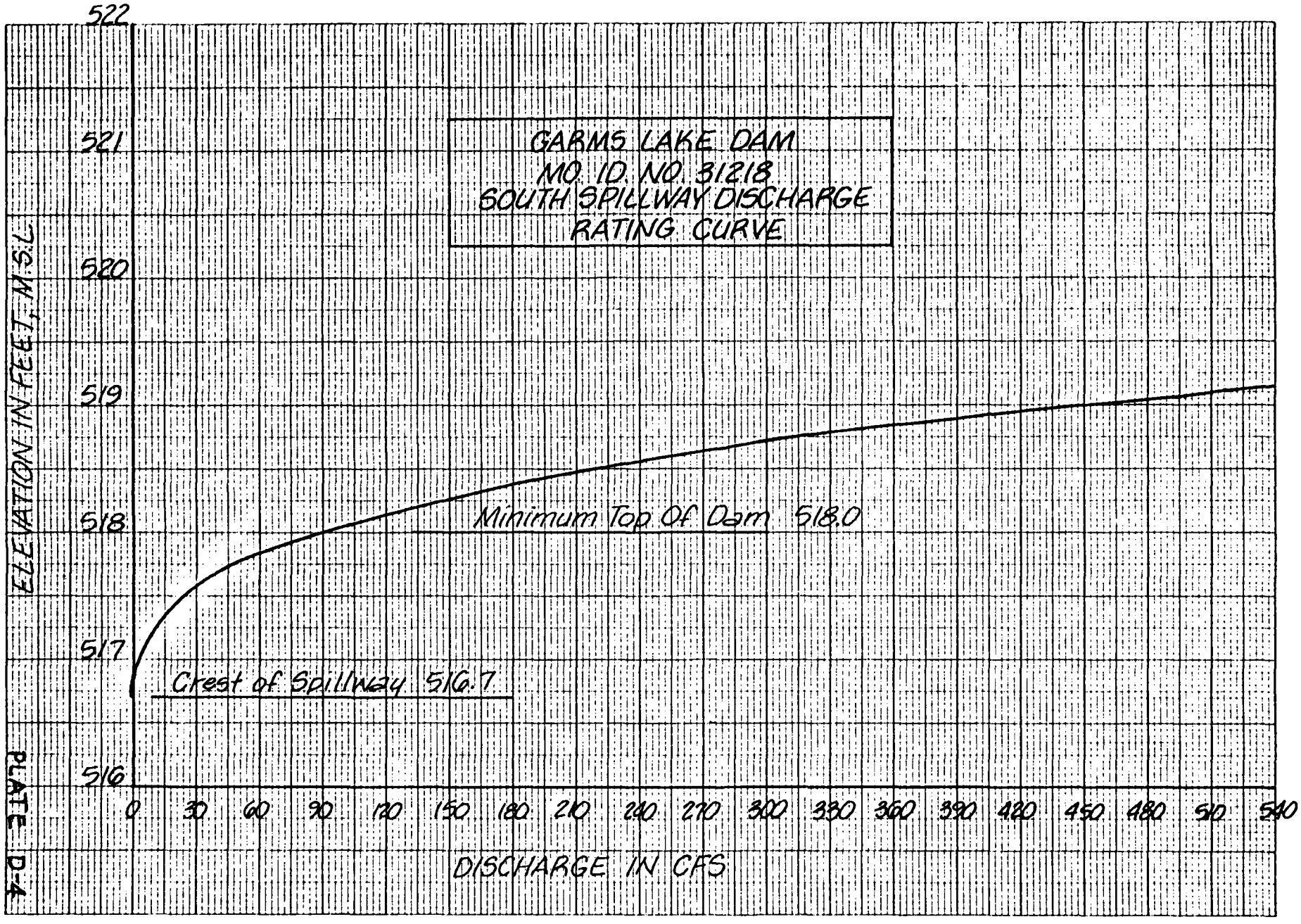


PLATE D-4

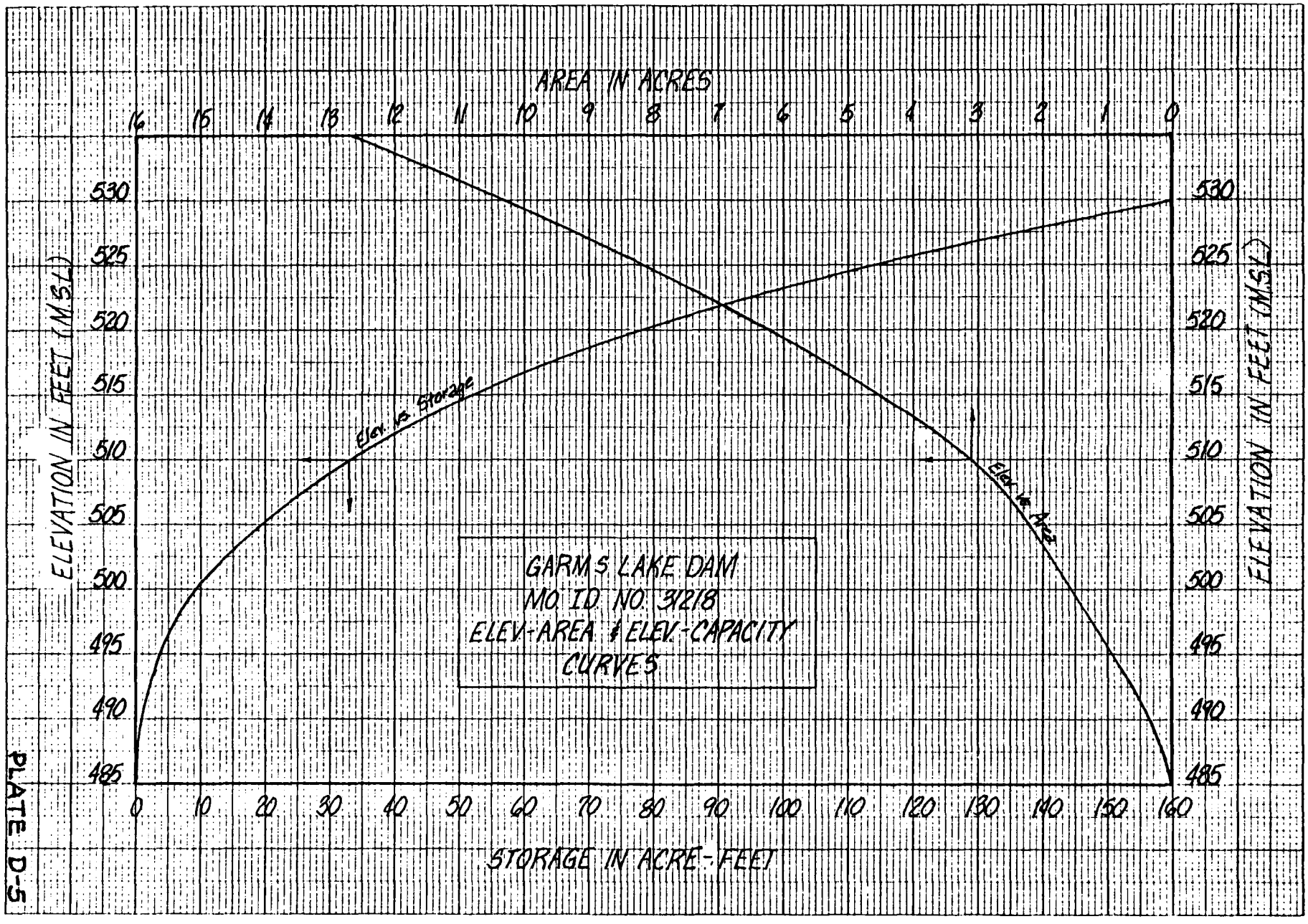


PLATE D-5

LISTING OF CARD INPUT DATA

```
A1                ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2                H & H ANALYSIS OF SAFETY OF GARMS LAKE DAM-MO 31218
A3                RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 000288000000000000000005                                  000000000000000000000003
B1000005
J 000001000000090000001
J1000.1500000.2000000.2500000.3000000.3500000.4000000.45000000.5000001.0
K 000000000000001                          000000000000000000000001
K1                CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 31218
M 000001000000020000.036          0000.036000001.0                        00000001
P 000000000027.000000102000001210000130
T                                                          -1.0    -82.0
W2       00000.17
X 000000     -.01000000001
K 000001000000002                          000000002000000000000001
K1                ROUTED FLOWS THROUGH RESERVOIR 31218
Y                          000000010000001
Y1000001                                                  -516.7       -1
Y40516.7000516.9000517.0000517.2000517.4000517.6000517.8000518.0000518.5000519.0
Y40519.5000520.0000521.0
Y500000000000000040000006.5000013.5000023.500000040000072.500000110000002700000051O
Y5000086000001325000002560
$A000000000000.34000001.6000003.1000006.3000010.3
$E0485.000000490000005000000051000000520000005300
$$0516.7
$D0518.0000002.9000001.500000500
$L000000000000006000000118000001780000021500000270000003750000052600000570000000585
$V0518.0000518.2000518.4000518.6000518.8000519.0000519.2000520.0000521.0000522.0
K 000099
A
A
A
A
A
```

PLATE D-6

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 000001
ROUTE HYDROGRAPH TO 000002
END OF NETWORK

PLATE D-7

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/12/01.
     TIME= 13.42.36.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
H & H ANALYSIS OF SAFETY OF GAMMS LAKE DAM-MO 31218
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	5	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .15 .20 .25 .30 .35 .40 .45 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 31218

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.04	0.00	.04	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-82.00	0.00	0.00

CURVE NO = -82.00 WETNESS = -1.00 EFFECT CN = 82.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .17

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00

25. 76. 78. 49. 24. 13. 7. 4. 2. 1.
1. 0.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.23	.21	.02	22.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.21	.02	35.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.21	.02	44.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.21	.01	52.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.22	.01	56.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.22	.01	58.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.22	.01	59.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.22	.01	60.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.22	.01	60.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.22	.01	60.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.22	.01	61.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.22	.01	61.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.26	.01	62.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.26	.01	66.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.27	.01	69.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.27	.01	71.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.27	.01	73.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.27	.01	73.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.28	.27	.01	74.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.28	.27	.01	74.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.28	.27	.01	74.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.28	.27	.01	74.

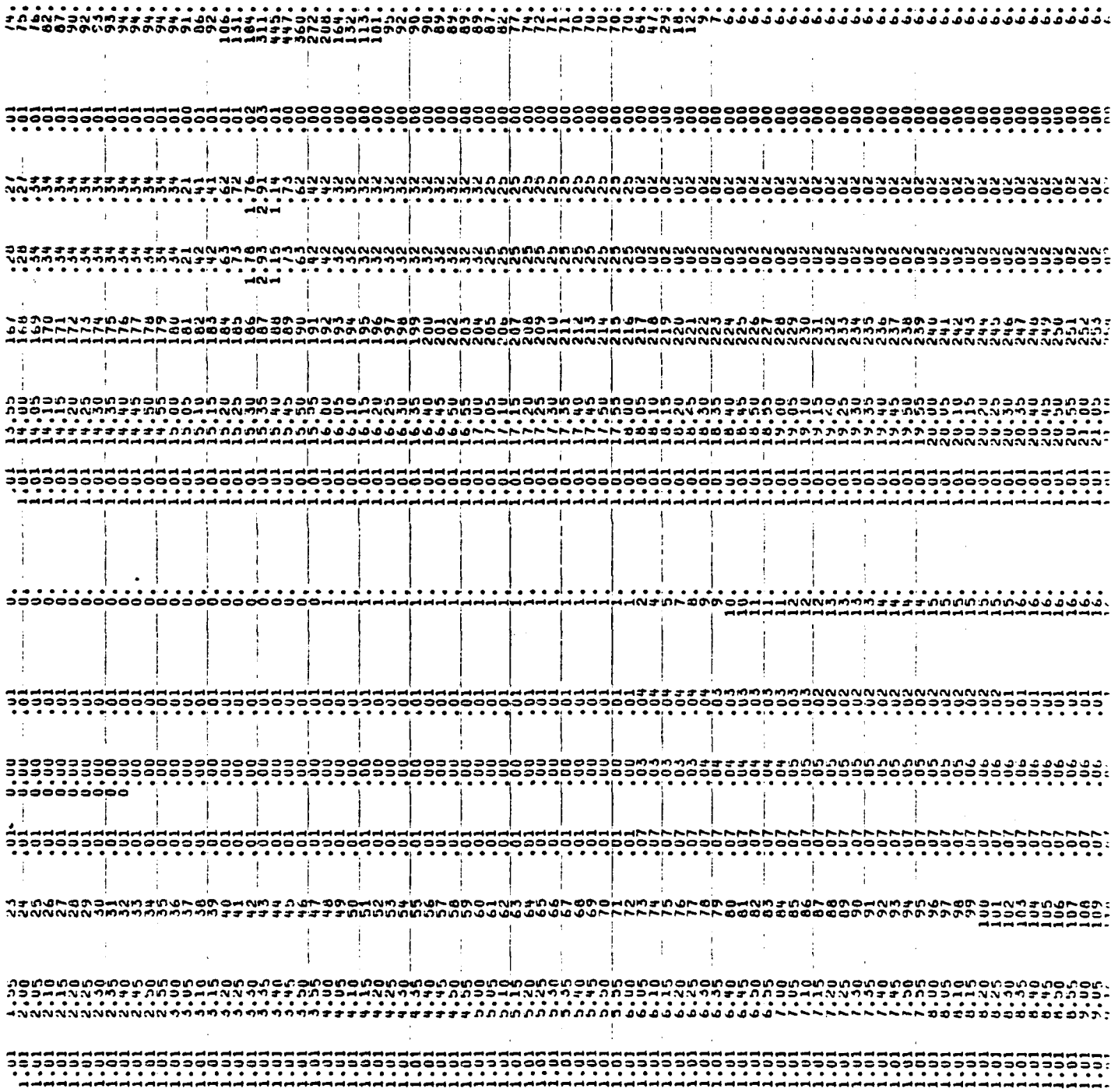


PLATE D-9

1.01	9.15	111	.07	.06	.01	16.	1.01	21.15	255	.02	.02	.00	6.
1.01	9.20	112	.07	.06	.01	17.	1.01	21.20	256	.02	.02	.00	6.
1.01	9.25	113	.07	.06	.01	17.	1.01	21.25	257	.02	.02	.00	6.
1.01	9.30	114	.07	.06	.01	17.	1.01	21.30	258	.02	.02	.00	6.
1.01	9.35	115	.07	.06	.01	17.	1.01	21.35	259	.02	.02	.00	6.
1.01	9.40	116	.07	.06	.01	17.	1.01	21.40	260	.02	.02	.00	6.
1.01	9.45	117	.07	.06	.01	17.	1.01	21.45	261	.02	.02	.00	6.
1.01	9.50	118	.07	.06	.01	17.	1.01	21.50	262	.02	.02	.00	6.
1.01	9.55	119	.07	.06	.01	17.	1.01	21.55	263	.02	.02	.00	6.
1.01	10.00	120	.07	.06	.01	17.	1.01	22.00	264	.02	.02	.00	6.
1.01	10.05	121	.07	.06	.01	17.	1.01	22.05	265	.02	.02	.00	6.
1.01	10.10	122	.07	.06	.01	17.	1.01	22.10	266	.02	.02	.00	6.
1.01	10.15	123	.07	.06	.01	17.	1.01	22.15	267	.02	.02	.00	6.
1.01	10.20	124	.07	.06	.01	17.	1.01	22.20	268	.02	.02	.00	6.
1.01	10.25	125	.07	.06	.01	17.	1.01	22.25	269	.02	.02	.00	6.
1.01	10.30	126	.07	.06	.01	17.	1.01	22.30	270	.02	.02	.00	6.
1.01	10.35	127	.07	.06	.01	18.	1.01	22.35	271	.02	.02	.00	6.
1.01	10.40	128	.07	.06	.01	18.	1.01	22.40	272	.02	.02	.00	6.
1.01	10.45	129	.07	.06	.01	18.	1.01	22.45	273	.02	.02	.00	6.
1.01	10.50	130	.07	.06	.01	18.	1.01	22.50	274	.02	.02	.00	6.
1.01	10.55	131	.07	.06	.01	18.	1.01	22.55	275	.02	.02	.00	6.
1.01	11.00	132	.07	.06	.01	18.	1.01	23.00	276	.02	.02	.00	6.
1.01	11.05	133	.07	.06	.01	18.	1.01	23.05	277	.02	.02	.00	6.
1.01	11.10	134	.07	.06	.01	18.	1.01	23.10	278	.02	.02	.00	6.
1.01	11.15	135	.07	.06	.01	18.	1.01	23.15	279	.02	.02	.00	6.
1.01	11.20	136	.07	.06	.01	18.	1.01	23.20	280	.02	.02	.00	6.
1.01	11.25	137	.07	.06	.01	18.	1.01	23.25	281	.02	.02	.00	6.
1.01	11.30	138	.07	.06	.01	18.	1.01	23.30	282	.02	.02	.00	6.
1.01	11.35	139	.07	.07	.01	18.	1.01	23.35	283	.02	.02	.00	6.
1.01	11.40	140	.07	.07	.01	18.	1.01	23.40	284	.02	.02	.00	6.
1.01	11.45	141	.07	.07	.01	18.	1.01	23.45	285	.02	.02	.00	6.
1.01	11.50	142	.07	.07	.01	18.	1.01	23.50	286	.02	.02	.00	6.
1.01	11.55	143	.07	.07	.01	18.	1.01	23.55	287	.02	.02	.00	6.
1.01	12.00	144	.07	.07	.01	18.	1.02	0.00	288	.02	.02	.00	6.
									SUM	35.10	32.60	2.50	9088.
										(892.)	(828.)	(64.)	(257.34)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	447.	104.	31.	31.	9067.
CMS	13.	3.	1.	1.	257.
INCHES		26.81	32.54	32.54	32.54
MM		681.05	826.52	826.52	826.52
AC-FT		51.	62.	62.	62.
THOUS CU M		63.	77.	77.	77.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	67.	16.	5.	5.	1360.
CMS	2.	0.	0.	0.	39.
INCHES		4.02	4.88	4.88	4.88
MM		102.16	123.98	123.98	123.98
AC-FT		8.	9.	9.	9.
THOUS CU M		10.	12.	12.	12.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	89.	21.	6.	6.	1813.
CMS	3.	1.	0.	0.	51.
INCHES		5.36	6.51	6.51	6.51
MM		136.21	165.30	165.30	165.30
AC-FT		10.	12.	12.	12.
THOUS CU M		13.	15.	15.	15.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	112.	26.	8.	8.	2267.
CMS	3.	1.	0.	0.	64.
INCHES		6.70	8.14	8.14	8.14
MM		170.26	206.63	206.63	206.63
AC-FT		13.	16.	16.	16.
THOUS CU M		16.	19.	19.	19.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CMS	4.	1.	0.	0.	77.
INCHES		8.04	9.76	9.76	9.76
MM		204.32	247.96	247.96	247.96
AC-FT		15.	19.	19.	19.
THOUS CU M		19.	23.	23.	23.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	156.	36.	11.	11.	3173.
CMS	4.	1.	0.	0.	90.
INCHES		9.38	11.39	11.39	11.39
MM		238.37	289.28	289.28	289.28
AC-FT		18.	22.	22.	22.
THOUS CU M		22.	27.	27.	27.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	179.	42.	13.	13.	3627.
CMS	5.	1.	0.	0.	103.
INCHES		10.73	13.02	13.02	13.02
MM		272.42	330.61	330.61	330.61
AC-FT		21.	25.	25.	25.
THOUS CU M		25.	31.	31.	31.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	201.	47.	14.	14.	4080.
CMS	6.	1.	0.	0.	116.
INCHES		12.07	14.64	14.64	14.64
MM		306.47	371.93	371.93	371.93
AC-FT		23.	28.	28.	28.
THOUS CU M		29.	35.	35.	35.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	224.	52.	16.	16.	4534.
CMS	6.	1.	0.	0.	128.
INCHES		13.41	16.27	16.27	16.27
MM		340.53	413.26	413.26	413.26
AC-FT		26.	31.	31.	31.
THOUS CU M		32.	39.	39.	39.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	447.	104.	31.	31.	9067.
CMS	13.	3.	1.	1.	257.
INCHES		26.81	32.54	32.54	32.54
MM		681.05	826.52	826.52	826.52
AC-FT		51.	62.	62.	62.
THOUS CU M		63.	77.	77.	77.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR 51218

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-517.	-1

STAGE	516.70	516.90	517.00	517.20	517.40	517.60	517.80	518.00	518.50	519.00
	519.50	520.00	521.00							

```
F.          0.00      4.00      6.50     13.50   2[illegible].50     40.00     72.50    110.00    270.00  [illegible].00
          860.00   1325.00   2560.00

SURFACE AREA=     0.        0.        2.        3.        6.       10.
    CAPACITY=     0.        1.        9.       33.       79.      161.
   ELEVATION=   485.      490.      500.      510.      520.      530.

                        CREL    SPWID    COQW    EXPW    ELEVL    COQL    CAREA    EXPL
                        516.7     0.0     0.0     0.0     0.0     0.0      0.0      0.0

                                                 DAM DATA
                                          TOPEL    COQD    EXPD   DAMWID
                                          518.0     2.9     1.5    500.

   CREST LENGTH      0.       60.      118.      178.      215.      270.      375.      526.      570.      585.
   AT OR BELOW
   ELEVATION      518.0     518.2     518.4     518.6     518.8     519.0     519.2     520.0     521.0     522.0

                                   STATION 000002, PLAN 1, RATIO 1

                                   END-OF-PERIOD HYDROGRAPH ORDINATES

                                              OUTFLOW
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        1.        1.        1.
      1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
      1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
      1.        1.        1.        1.        1.        1.        2.        2.        2.        2.
      2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
      2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
      2.        2.        2.        2.        2.        2.        2.        2.        3.        3.
      3.        3.        3.        3.        3.        4.        4.        4.        4.        4.
      5.        5.        5.        5.        5.        6.        6.        6.        6.        6.
      6.        7.        7.        7.        8.        8.        8.        8.        9.        9.
      9.        9.       10.       10.       10.       11.       12.       14.       17.       20.
     22.       23.       23.       23.       23.       22.       22.       21.       21.       20.
     20.       20.       19.       19.       18.       18.       18.       17.       17.       17.
     16.       16.       16.       15.       15.       15.       14.       14.       13.       13.
     13.       12.       12.       11.       11.       10.       10.        9.        9.        9.
      8.        8.        8.        7.        7.        7.        7.        6.        6.        6.
      6.        6.        6.        5.        5.        5.        5.        5.        5.        5.
      4.        4.        4.        4.        4.        4.        4.        4.        4.        4.
      4.        3.        3.        3.        3.        3.        3.        3.        3.        3.
      3.        3.        3.        3.        3.        3.        3.        3.        3.        2.
      2.        2.        2.        2.        2.        2.        2.        2.

                                              STORAGE
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.       60.       61.
     61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       62.       62.       62.       62.       62.       62.       62.
     62.       62.       62.       62.       62.       62.       62.       62.       63.       63.
     63.       63.       63.       63.       63.       63.       63.       63.       63.       63.
     63.       63.       63.       63.       63.       63.       63.       63.       63.       63.
     63.       63.       63.       63.       63.       63.       63.       62.       62.       62.
     62.       62.       62.       62.       62.       62.       62.       62.       62.       62.
     62.       62.       62.       62.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
     61.       61.       61.       61.       61.       61.       61.       60.       60.       60.
     60.       60.       60.       60.       60.       60.       60.       60.

                                              STAGE
    516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
```

```
                    STATION 000002, PLAN 1, RATIO 6 0.4 PMF
                      END-OF-PERIOD HYDROGRAPH ORDINATES

                                   OUTFLOW
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
     0.      0.      0.      0.      0.      0.      0.      0.      1.      1.
     1.      1.      1.      1.      1.      1.      1.      1.      1.      2.
     2.      2.      2.      2.      2.      2.      2.      2.      2.      3.
     3.      3.      3.      3.      3.      3.      3.      3.      3.      3.
     4.      4.      4.      4.      4.      4.      4.      4.      4.      4.
     4.      4.      5.      5.      5.      5.      5.      5.      5.      5.
     5.      5.      5.      5.      5.      5.      5.      6.      6.      6.
     6.      6.      6.      6.      6.      6.      6.      7.      8.      8.
     9.     10.     10.     11.     11.     12.     13.     13.     14.     15.
    16.     16.     17.     18.     19.     19.     20.     21.     21.     22.
    23.     23.     25.     26.     27.     28.     29.     30.     31.     31.
    32.     32.     33.     33.     35.     37.     47.     66.     89.    104.
   108.    106.     99.     91.     82.     74.     67.     62.     57.     53.
    50.     48.     45.     44.     42.     41.     39.     39.     38.     37.
    36.     35.     34.     34.     33.     33.     32.     31.     30.     28.
    25.     23.     22.     21.     20.     19.     18.     17.     16.     15.
    14.     14.     13.     13.     12.     12.     11.     11.     10.     10.
    10.      9.      9.      9.      8.      8.      8.      8.      7.      7.
     7.      7.      7.      6.      6.      6.      6.      6.      6.      6.
     6.      5.      5.      5.      5.      5.      5.      5.      5.      5.
     5.      5.      4.      4.      4.      4.      4.      4.      4.      4.
     4.      4.      4.      4.      4.      4.      4.      4.

                                   STORAGE
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    60.     60.     60.     60.     60.     60.     60.     60.     60.     60.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     62.     62.
    62.     62.     62.     62.     62.     62.     62.     62.     62.     63.
    63.     63.     63.     63.     63.     63.     63.     63.     63.     63.
    63.     63.     64.     64.     64.     64.     64.     64.     64.     64.
    64.     64.     64.     64.     64.     64.     65.     65.     66.     67.
    67.     67.     66.     66.     66.     66.     66.     65.     65.     65.
    65.     65.     65.     65.     65.     65.     65.     64.     64.     64.
    64.     64.     64.     64.     64.     64.     64.     64.     64.     64.
    64.     63.     63.     63.     63.     63.     63.     63.     63.     63.
    63.     62.     62.     62.     62.     62.     62.     62.     62.     62.
    62.     62.     62.     62.     62.     62.     62.     62.     62.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.     61.     61.
    61.     61.     61.     61.     61.     61.     61.     61.

                                    STAGE
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7   516.7
  516.7   516.7   516.7   516.8   516.8   516.8   516.8   516.8   516.8   516.8
  516.8   516.8   516.8   516.8   516.8   516.8   516.8   516.8   516.8   516.8
  516.8   516.8   516.8   516.8   516.9   516.9   516.9   516.9   516.9   516.9
  516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9
  516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9   516.9
  516.9   516.9   516.9   517.0   517.0   517.0   517.0   517.0   517.0   517.0
  517.0   517.0   517.0   517.0   517.0   517.0   517.0   517.0   517.0   517.0
  517.1   517.1   517.1   517.1   517.1   517.2   517.2   517.2   517.2   517.2
```

517.4	517.4	517.4	517.4	517.4	[illegible]	517.5	517.5	517.5	517.5
517.5	517.5	517.5	517.5	517.5	517.6	517.6	517.8	517.9	518.0
518.0	518.0	517.9	517.9	517.9	517.8	517.8	517.7	517.7	517.7
517.7	517.6	517.6	517.6	517.6	517.6	517.6	517.6	517.6	517.6
517.6	517.5	517.5	517.5	517.5	517.5	517.5	517.5	517.5	517.5
517.4	517.4	517.4	517.4	517.3	517.3	517.3	517.3	517.2	517.2
517.2	517.2	517.2	517.2	517.2	517.1	517.1	517.1	517.1	517.1
517.1	517.1	517.1	517.1	517.1	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	516.9	516.9	516.9	516.9	516.9	516.9	516.9
516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9
516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9		

K OUTFLOW IS 108. AT TIME 15.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	108.	38.	12.	12.	3492.
CMS	3.	1.	0.	0.	99.
INCHES		9.84	12.53	12.53	12.53
MM		249.98	318.35	318.35	318.35
AC-FT		19.	24.	24.	24.
THOUS CU M		23.	30.	30.	30.

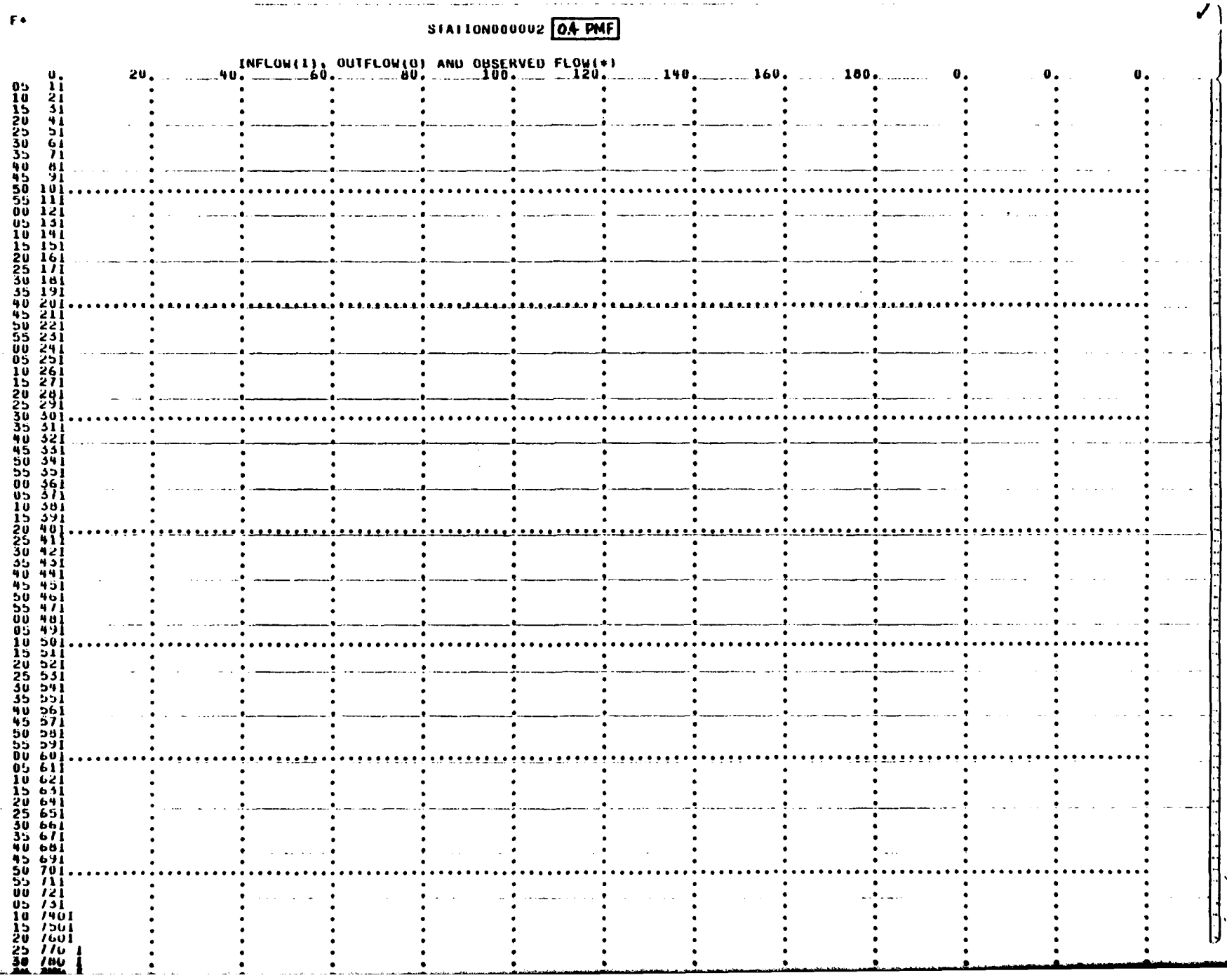

F+
STATION000002 0.4 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 20. 40. 60. 80. 100. 120. 140. 160. 180. 0. 0. 0.

PLATE D-15

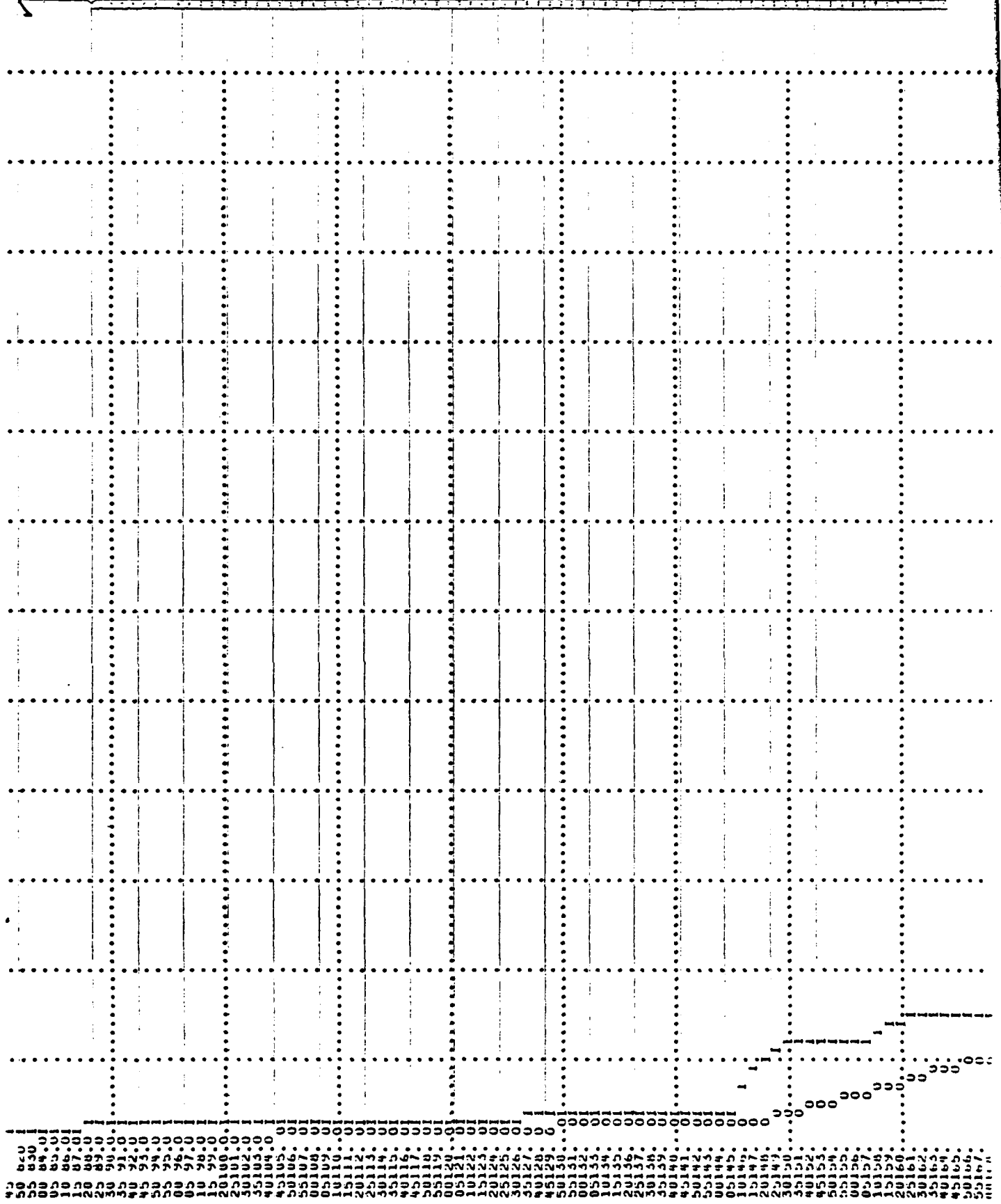


PLATE D-16

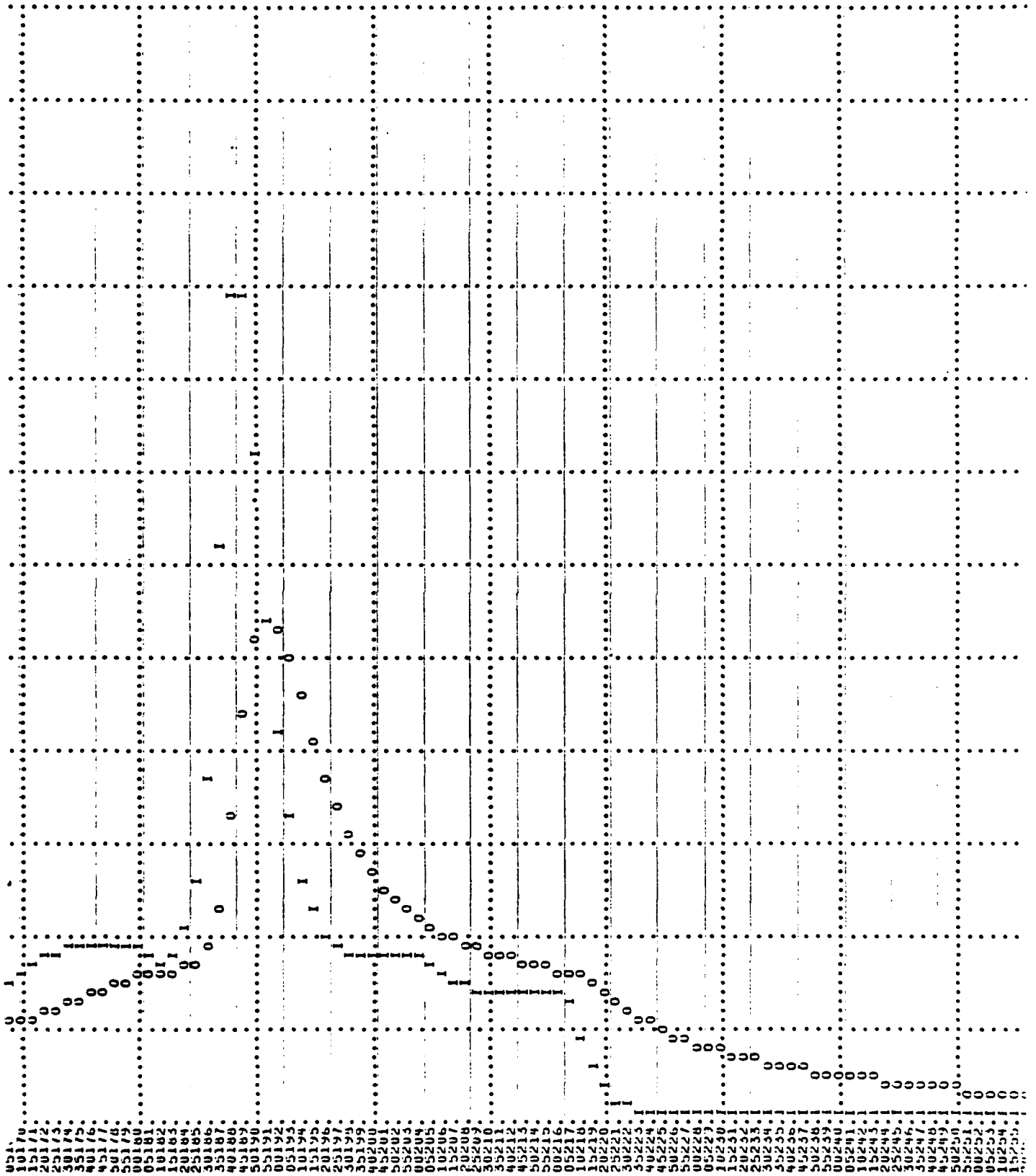


PLATE D-17

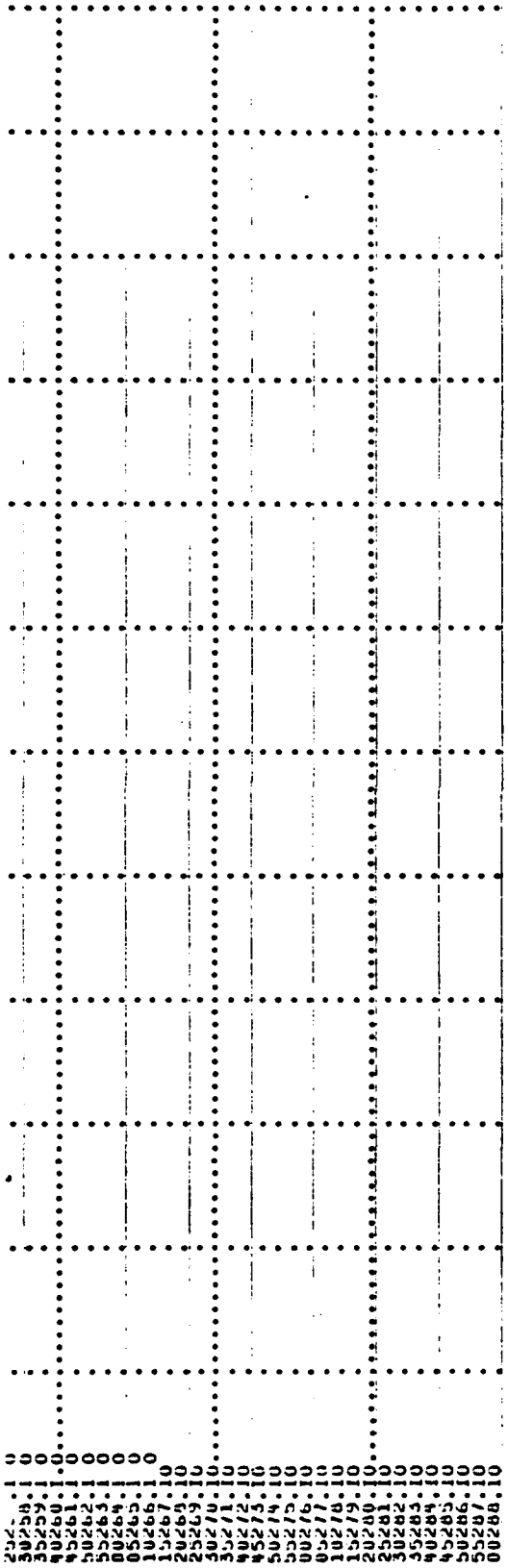


PLATE D-18

VN*

```
                         STATION 000002, PLAN 1, RATIO 8  0.5 PMF
                         END-OF-PERIOD HYDROGRAPH ORDINATES
                                     OUTFLOW
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        1.        1.        1.
     1.        1.        1.        1.        1.        2.        2.        2.        2.        2.
     2.        2.        2.        2.        3.        3.        3.        3.        3.        3.
     3.        3.        4.        4.        4.        4.        4.        4.        4.        4.
     4.        5.        5.        5.        5.        5.        5.        5.        5.        5.
     6.        6.        6.        6.        6.        6.        6.        6.        6.        6.
     6.        7.        7.        7.        7.        7.        7.        7.        7.        7.
     7.        7.        8.        8.        8.        8.        8.        9.       10.       11.
    12.       12.       13.       14.       15.       16.       17.       18.       19.       20.
    21.       22.       23.       24.       25.       26.       27.       28.       29.       30.
    31.       33.       34.       35.       36.       37.       38.       39.       40.       41.
    42.       42.       43.       44.       47.       53.       66.       91.      123.      151.
   153.      141.      125.      109.       99.       89.       81.       74.       68.       64.
    61.       58.       55.       53.       52.       50.       48.       46.       44.       43.
    41.       40.       40.       39.       39.       38.       38.       37.       35.       33.
    30.       28.       26.       23.       22.       21.       20.       19.       18.       17.
    16.       15.       14.       14.       13.       13.       12.       12.       11.       11.
    11.       10.       10.       10.        9.        9.        9.        9.        8.        8.
     8.        8.        7.        7.        7.        7.        7.        6.        6.        6.
     6.        6.        6.        6.        6.        6.        6.        5.        5.        5.
     5.        5.        5.        5.        5.        5.        5.        5.        5.        5.
     5.        4.        4.        4.        4.        4.        4.        4.

                                     STORAGE
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       60.       60.       60.       60.       60.       60.
    60.       60.       60.       60.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       62.
    62.       62.       62.       62.       62.       62.       62.       62.       62.       62.
    62.       62.       62.       63.       63.       63.       63.       63.       63.       63.
    63.       63.       63.       64.       64.       64.       64.       64.       64.       64.
    64.       64.       64.       64.       64.       64.       64.       65.       65.       65.
    65.       65.       65.       65.       65.       65.       65.       66.       67.       67.
    68.       67.       67.       67.       66.       66.       66.       66.       66.       65.
    65.       65.       65.       65.       65.       65.       65.       65.       65.       65.
    65.       65.       65.       65.       65.       64.       64.       64.       64.       65.
    64.       64.       64.       63.       63.       63.       63.       63.       63.       64.
    63.       63.       63.       62.       62.       62.       62.       62.       62.       63.
    62.       62.       62.       62.       62.       62.       62.       62.       62.       62.
    62.       62.       62.       61.       61.       61.       61.       61.       61.       62.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.       61.       61.
    61.       61.       61.       61.       61.       61.       61.       61.

                                      STAGE
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7     516.7
   516.7     516.8     516.8     516.8     516.8     516.8     516.8     516.8     516.8     516.8
   516.8     516.8     516.8     516.8     516.8     516.8     516.8     516.8     516.9     516.9
   516.9     516.9     516.9     516.9     516.9     516.9     516.9     516.9     516.9     516.9
   516.9     516.9     516.9     516.9     516.9     516.9     516.9     517.0     517.0     517.0
   517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0
   517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0     517.0
   517.0     517.0     517.0     517.0     517.0     517.0     517.1     517.1     517.1     517.1
   517.1     517.2     517.2     517.2     517.2     517.3     517.3     517.3     517.3     517.3
```

517.5	517.5	517.5	517.5	517.6	.6	517.6	517.6	517.6	517.6
517.6	517.6	517.6	517.6	517.6	517.7	517.8	517.9	518.0	518.1
518.1	518.1	518.0	518.0	517.9	517.9	517.8	517.8	517.8	517.7
517.7	517.7	517.7	517.7	517.7	517.7	517.7	517.6	517.6	517.6
517.6	517.6	517.6	517.6	517.6	517.6	517.6	517.6	517.5	517.5
517.5	517.5	517.4	517.4	517.4	517.4	517.3	517.3	517.3	517.3
517.3	517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.1	517.1
517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.0
517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0
516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9
516.9	516.9	516.9	516.9	516.9	516.9	516.9	516.9		

AK OUTFLOW IS 153. AT TIME 15.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	153.	48.	15.	15.	4381.
CMS	4.	1.	0.	0.	124.
INCHES		12.49	15.72	15.72	15.72
MM		317.33	399.37	399.37	399.37
AC-FT		24.	30.	30.	30.
THOUS CU M		30.	37.	37.	37.

STATION000002 0.5 PMF

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

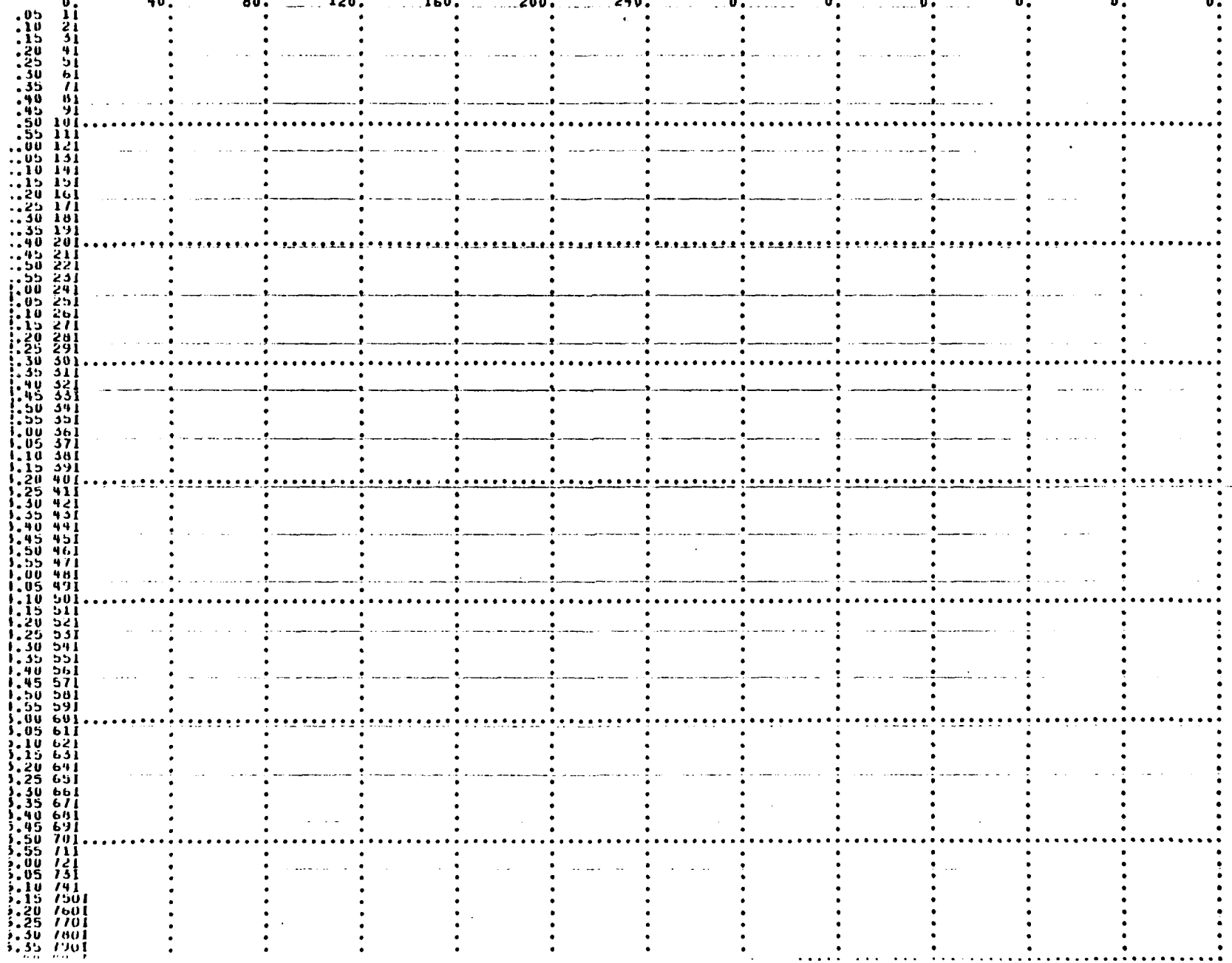


PLATE D-21

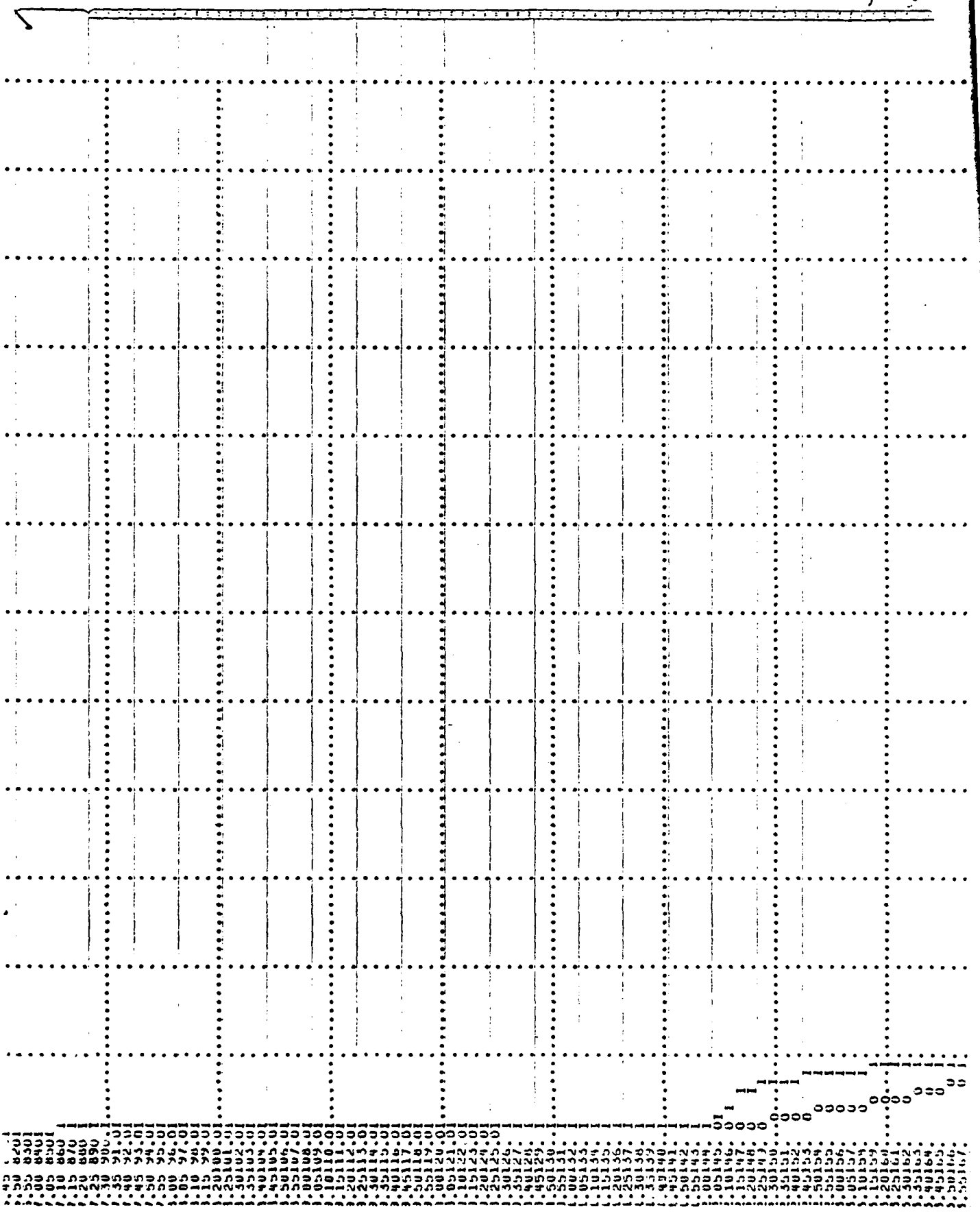


PLATE D-22

PLATE D-23

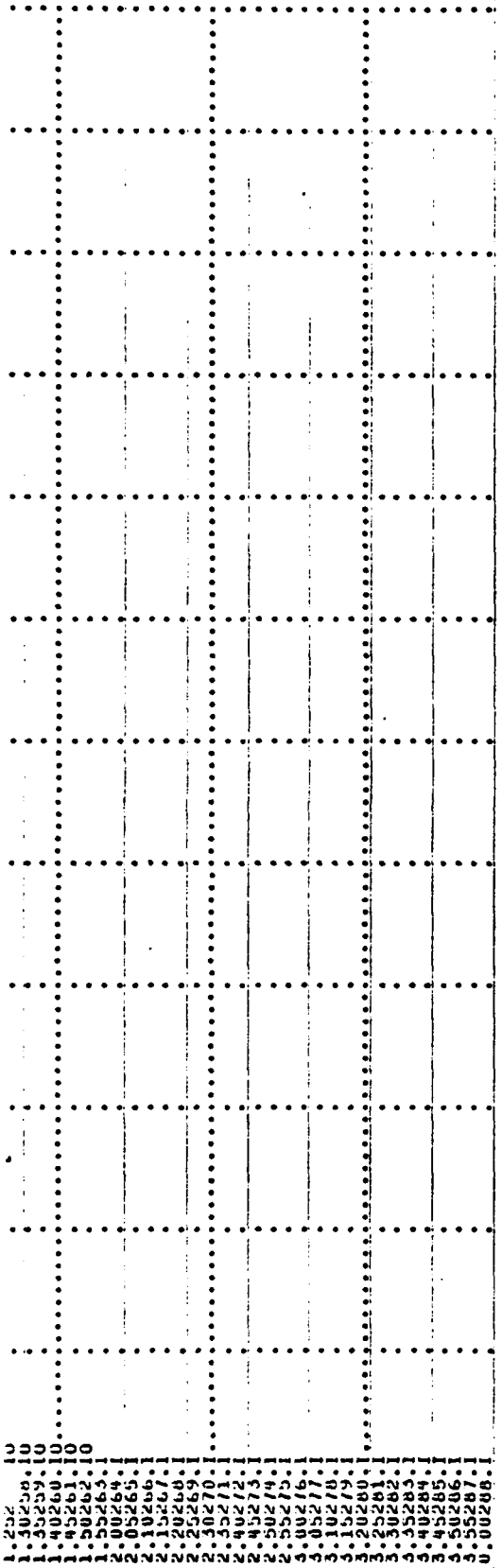


PLATE D-24

UVN*

STATION 000002, PLAN 1, RATIO 9 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	3.	3.	3.	3.	3.	4.	4.
4.	5.	5.	5.	5.	6.	6.	6.	7.	7.
7.	8.	8.	8.	9.	9.	9.	10.	10.	10.
11.	11.	11.	11.	12.	12.	12.	12.	12.	13.
13.	13.	13.	13.	14.	14.	14.	14.	15.	15.
15.	15.	15.	15.	16.	16.	16.	16.	16.	16.
16.	16.	17.	17.	17.	18.	19.	21.	23.	26.
29.	32.	35.	37.	39.	43.	46.	49.	53.	56.
59.	61.	63.	65.	67.	68.	69.	70.	71.	73.
75.	78.	80.	83.	85.	87.	88.	89.	90.	91.
91.	91.	90.	92.	98.	110.	158.	250.	355.	388.
340.	286.	238.	198.	168.	146.	129.	117.	110.	106.
103.	100.	98.	96.	95.	93.	90.	87.	84.	82.
79.	78.	76.	75.	74.	73.	72.	69.	63.	56.
40.	41.	37.	34.	32.	29.	27.	25.	23.	22.
21.	20.	19.	18.	18.	17.	16.	15.	15.	14.
14.	13.	13.	13.	12.	12.	12.	11.	11.	11.
11.	11.	10.	10.	10.	10.	10.	9.	9.	9.
9.	9.	9.	8.	8.	8.	8.	8.	8.	8.
8.	8.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.		

STORAGE

60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
62.	62.	62.	62.	62.	62.	63.	63.	63.	63.
63.	63.	63.	63.	63.	63.	63.	63.	63.	63.
63.	63.	63.	63.	63.	63.	63.	63.	63.	64.
64.	64.	64.	64.	65.	65.	65.	65.	65.	65.
65.	65.	65.	65.	65.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	67.	68.	69.	70.	70.
70.	69.	69.	68.	60.	67.	67.	67.	67.	67.
67.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	65.	65.
65.	65.	64.	64.	64.	64.	64.	64.	63.	63.
63.	63.	63.	63.	63.	63.	63.	63.	63.	63.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
62.	62.	62.	62.	62.	62.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.		

STAGE

516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.7
516.7	516.7	516.7	516.7	516.7	516.7	516.7	516.8	516.8	516.8
516.8	516.8	516.8	516.8	516.8	516.9	516.9	516.9	516.9	516.9
516.9	516.9	516.9	516.9	517.0	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	517.1	517.1	517.1	517.1	517.1	517.1	517.1
517.1	517.1	517.1	517.1	517.1	517.2	517.2	517.2	517.2	517.2
517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.2
517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.2	517.3	517.3
517.3	517.3	517.3	517.3	517.3	517.3	517.3	517.3	517.4	517.4
517.5	517.5	517.5	517.6	517.6	517.6	517.6	517.7	517.7	517.7
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

517.8	517.8	517.8	517.9	517.9	.9	517.9	517.9	517.9	517.9
517.9	517.9	517.9	517.9	517.9	518.0	518.1	518.4	518.5	518.6
518.5	518.4	518.3	518.2	518.2	518.1	518.1	518.0	518.0	518.0
518.0	517.9	517.9	517.9	517.9	517.9	517.8	517.9	517.9	517.8
517.8	517.8	517.8	517.8	517.8	517.8	517.8	517.8	517.7	517.7
517.7	517.6	517.6	517.5	517.5	517.5	517.4	517.4	517.4	517.4
517.3	517.3	517.3	517.3	517.3	517.3	517.3	517.2	517.2	517.2
517.2	517.2	517.2	517.2	517.2	517.2	517.1	517.1	517.1	517.1
517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.1	517.1
517.1	517.1	517.1	517.1	517.1	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0
517.0	517.0	517.0	517.0	517.0	517.0	517.0	517.0		

PEAK OUTFLOW IS 388. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	388.	100.	31.	31.	8841.
CMS	11.	3.	1.	1.	250.
INCHES		25.96	31.73	31.73	31.73
MM		659.47	805.92	805.92	805.92
AC-FT		50.	61.	61.	61.
THOUS CU M		61.	75.	75.	75.

PLATE D-26

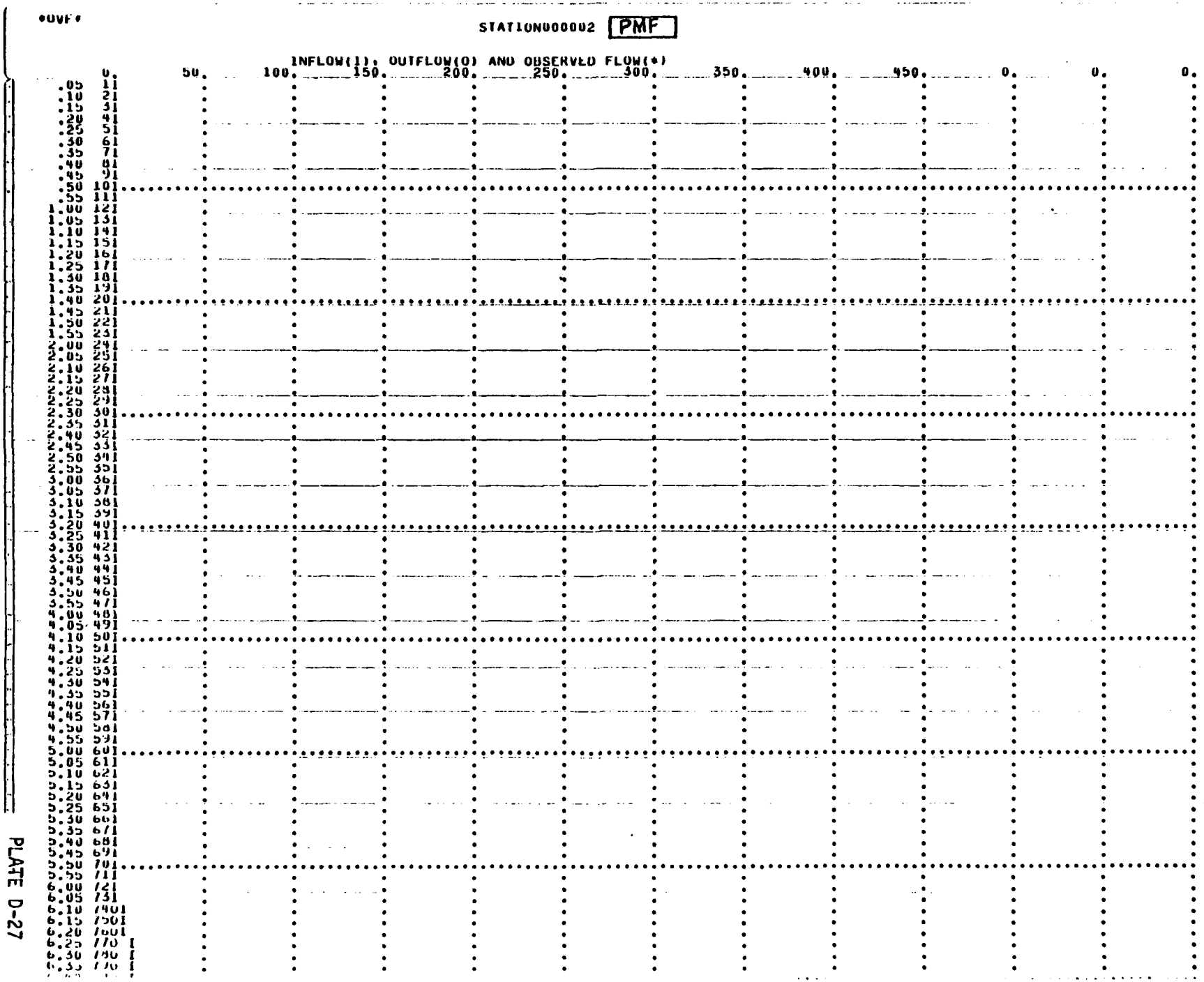

OVF
STATION00002
PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0
50
100
150
200
250
300
350
400
450
0
0
0

PLATE D-27

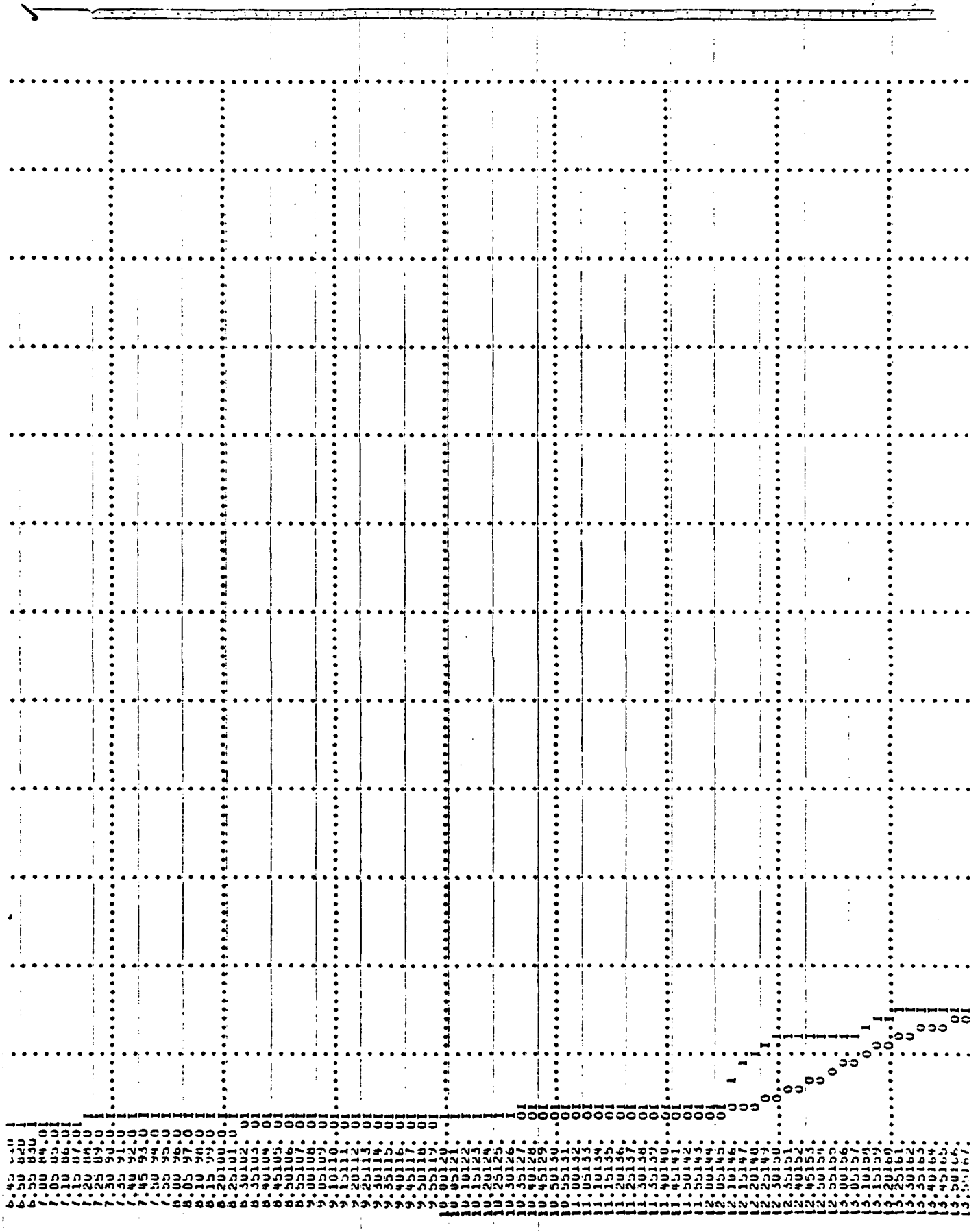


PLATE D-28

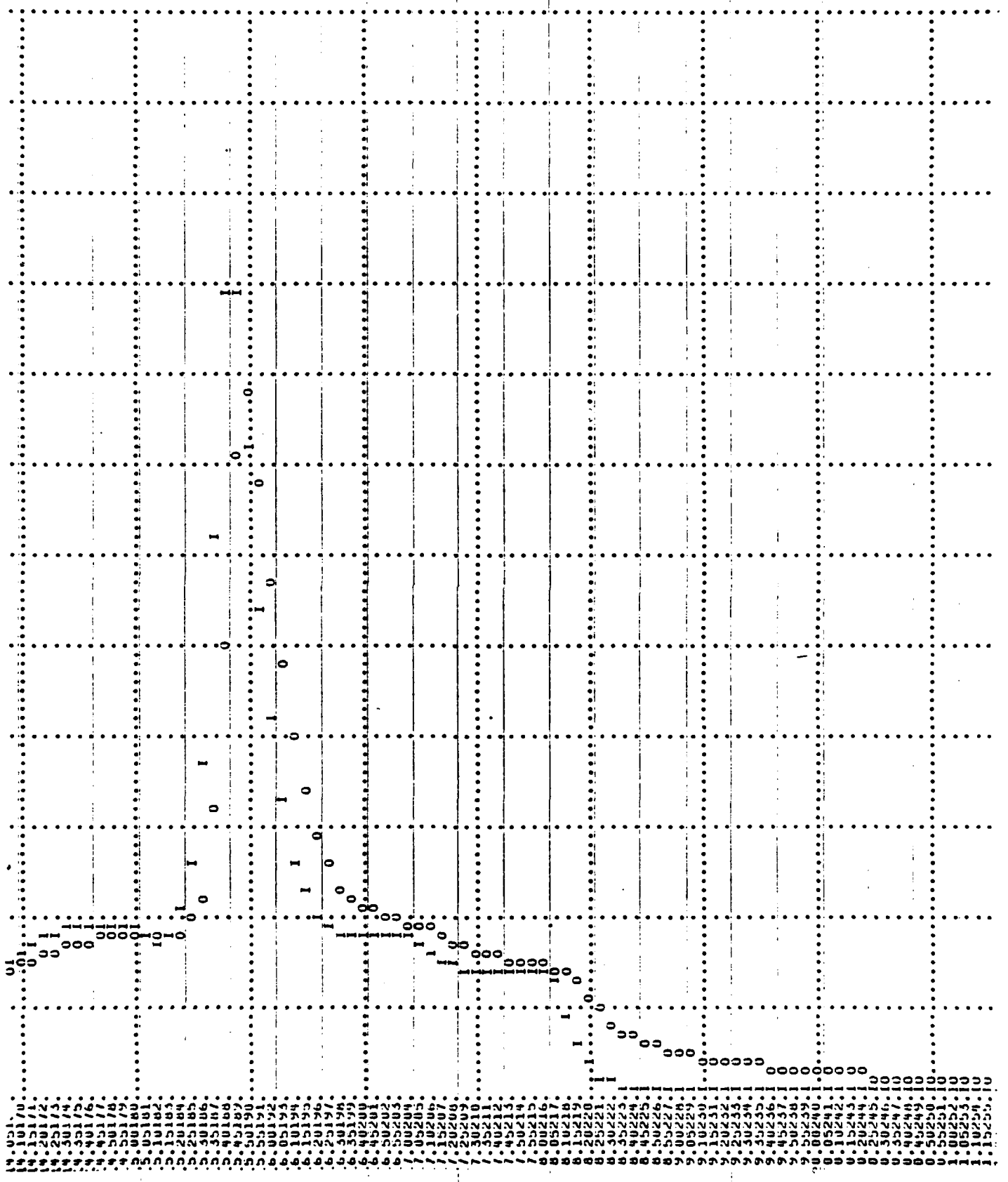


PLATE D-29

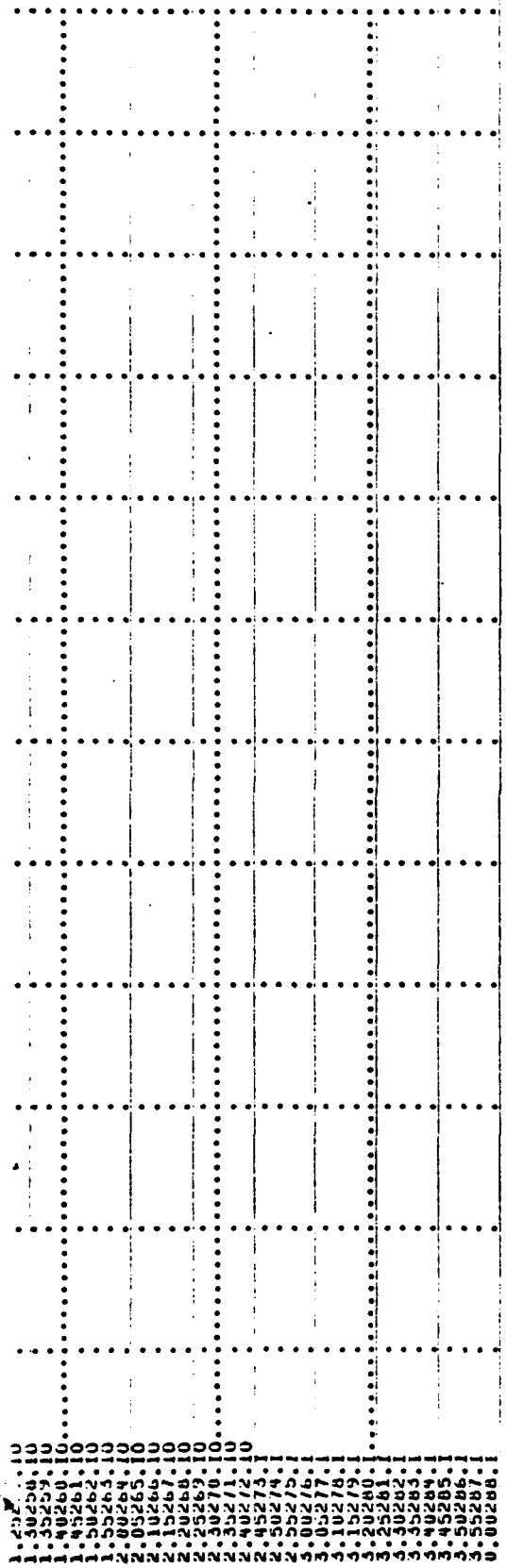


PLATE D-30

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .15	RATIO 2 .20	RATIO 3 .25	RATIO 4 .30	RATIO 5 .35	RATIO 6 .40	RATIO 7 .45	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	000001	.04	1	67.	89.	112.	134.	156.	179.	201.	224.	447.
		(.09)		(1.90)	(2.53)	(3.16)	(3.80)	(4.43)	(5.06)	(5.70)	(6.33)	(12.66)
ROUTED TO	000002	.04	1	23.	36.	55.	73.	91.	108.	132.	153.	388.
		(.09)		(.65)	(1.03)	(1.55)	(2.05)	(2.59)	(3.07)	(3.73)	(4.34)	(10.98)

PLATE D-31

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	516.70	516.70	518.00
STORAGE	60.	60.	67.
OUTFLOW	0.	0.	110.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.15	517.59	0.00	64.	23.	0.00	16.08	0.00
.20	517.56	0.00	64.	36.	0.00	16.08	0.00
.25	517.69	0.00	65.	55.	0.00	16.00	0.00
.30	517.80	0.00	66.	73.	0.00	15.92	0.00
.35	517.90	0.00	66.	91.	0.00	15.92	0.00
.40	517.99	0.00	67.	108.	0.00	15.92	0.00
.45	518.07	.07	67.	132.	.33	15.92	0.00
.50	518.13	.13	68.	153.	.42	15.92	0.00
1.00	518.56	.56	70.	388.	1.08	15.83	0.00

PLATE D-32


FILME